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VOLUME NO. 2

EXPLANATORY NOTES

FOR

DEPARTMENT OF AGRICULTURE

BUDGET ESTIMATES

FISCAL YEAR

1944



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AGRICULTURAL RESEARCH ADMINISTRATION

OFFICE OF ADMINISTRATOR

Appropriation Act, 1943	-,-
Proposed transfers in 1944 estimates from:	
"Salaries and expenses, Bureau of Animal Industry, general administrative expenses"	+\$2,000
"Salaries and expenses, Bureau of Animal Industry, animal husbandry"	+6,000
"Salaries and expenses, Bureau of Animal Industry, diseases of animals"	+6,000
"Salaries and expenses, Bureau of Dairy Industry"	+3,000
"Salaries and expenses, Bureau of Plant Industry, general administrative expenses"	+12,000
"Salaries and expenses, Bureau of Plant Industry, cereal crops and diseases"	+2,500
"Salaries and expenses, Bureau of Plant Industry, cotton and other fiber crops and diseases"	+2,000
"Salaries and expenses, Bureau of Plant Industry, fruit and vegetable crops and diseases"	+6,000
"Salaries and expenses, Bureau of Plant Industry, sugar-plant investigations"	+1,500
"Salaries and expenses, Bureau of Agricultural Chemistry and Engineering, general administrative expenses"	+4,000
"Salaries and expenses, Bureau of Entomology and Plant Quarantine, general administrative expenses"	+2,000
"Salaries and expenses, Bureau of Entomology and Plant Quarantine, fruit insects"	+4,000
"Salaries and expenses, Bureau of Entomology and Plant Quarantine, Dutch elm disease eradication"	+4,000
"Salaries and expenses, Bureau of Entomology and Plant Quarantine, cereal and forage insects"	+3,000
"Salaries and expenses, Bureau of Entomology and Plant Quarantine, barberry eradication"	+3,000
"Salaries and expenses, Bureau of Home Economics"	+1,000
Total available, 1943	62,000
Budget estimate, 1944	61,965
Decrease (travel funds returned to surplus)	-35

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Administration and direc- tion of the Agricultural Research Administration	\$16,783	\$61,965	\$61,965	- -
Covered into Treasury in accordance with Public Law 674	- -	35	- -	-\$35
Unobligated balance	1,217	- -	- -	- -
Total estimate or appropriation	18,000	62,000	61,965	-35

DECREASE

The decrease of \$35 in this item for 1944 consists of a decrease in travel funds (returned to surplus in 1943).

CHANGE IN LANGUAGE

The estimates include the following proposed new language:

AGRICULTURAL RESEARCH ADMINISTRATION

OFFICE OF ADMINISTRATOR

Salaries and expenses: For necessary salaries and expenses of the Office of Administrator, including the salary of the Administrator at \$10,000 per annum and personal services in the District of Columbia and elsewhere, \$61,965.

The language recommended is to provide for a main heading, Agricultural Research Administration, established by Executive Order No. 9069, dated February 23, 1942, and Memorandum No. 986 of the Secretary of Agriculture, dated February 25, 1942, in order to reflect this Administration in the appropriation act, and to provide for financing the Office of Administrator, Agricultural Research Administration. The amount indicated for appropriation is made up of transfers from constituent agencies of the Administration with corresponding reductions in the appropriations of the agencies from which the transfers are made.

It is recommended that authority be included in the language for the payment of the salary of the Administrator at \$10,000 per annum, in order that it will be commensurate with the newly established responsibilities arising out

of centralizing administration of the research work of the Department. This involves both over-all responsibilities for Departmental research and administration of the functions of the 8 bureaus which now comprise the Agricultural Research Administration.

WORK UNDER THIS APPROPRIATION

The President, in Executive Order 9069, dated February 23, 1942, established the Agricultural Research Administration, consolidating into the one Administration, the Bureau of Animal Industry, Bureau of Dairy Industry, Bureau of Plant Industry, Bureau of Agricultural Chemistry and Engineering, Bureau of Entomology and Plant Quarantine, Bureau of Home Economics, Office of Experiment Stations, and the Beltsville Research Center. Pursuant to this Executive Order, the Secretary of Agriculture on February 25, 1942, established each of the foregoing organizational units as constituent agencies of the Agricultural Research Administration with the same functions, personnel, positions, property, and records that previously constituted the agency of the same designation, except that:

(a) the activities of each of the agencies are subject to the direction and supervision of the Administrator of the Agricultural Research Administration;

(b) the Administrator may transfer to his immediate office from any agency such personnel, property, and records as he may require for the proper discharge of his duties;

(c) the Administrator may take such action as he deems to be appropriate with respect to consolidating or integrating the work of the several divisions, sections, and units which are engaged in the performance of business, personnel, information, administrative, or other facilitating services; and

(d) the Administrator may take such action as he feels advisable with respect to integrating or consolidating the research of the several bureaus, divisions, sections and units in order to promote economy and efficiency and to concentrate the Department's research efforts on problems that are most vital to the production and utilization of agricultural commodities.

(e) the Administrator of the Agricultural Research Administration may delegate to other officials or employees of the Administration or of the several agencies which constitute the Administration any of the authority now or hereafter conferred upon the Administrator.

In addition, the Agricultural Research Administrator, by order of the Secretary, is authorized and directed "to obtain from all agencies of the Department information concerning the current and contemplated research activities of such agencies, to advise the heads of departmental agencies concerning research plans and programs, and to make reports and recommendations to the Secretary of Agriculture regarding the research activities, plans and programs of the several agencies of the Department." The Administrator, furthermore, has general supervision of the activities under the Special Research Fund and of the Regional Research Laboratories authorized by Section 202 of the Agricultural Adjustment Act of 1938.

Organization: The Agricultural Research Administration is under the direction and supervision of the Agricultural Research Administrator, who is directly responsible to the Secretary. The immediate staff of the Administrator consists of an Assistant Administrator, an Assistant to the Administrator, eight Coordinators, a Budget Officer and necessary clerical assistants. The Agricultural Research Administrator, in addition, has direct supervision over the Special Research Fund regional research laboratory for research into the relation of soils to plant, animal and human nutrition, the activities of which are described under the Special Research Fund.

Functions: The Office of Administrator plans, develops, coordinates, and directs the scientific research program of the Agricultural Research Administration to assure the most effective utilization of personnel and facilities; relates the Department's research program with those going forward in private industry and in other Governmental establishments; and determines research objectives in the light of the changing needs of agriculture and of the Nation for foods and fiber.

Financial Support: The Office of Administrator was financed during the latter part of 1942, and is being financed in 1943 by transfers and allotments from funds appropriated to the constituent agencies. For 1944, and thereafter, it is recommended that the funds transferred in 1943 be consolidated into, and appropriated under, the new item "Office of Administrator" with corresponding reductions in the other appropriations involved. Allotments from the Special Research Fund and from the funds of the four Regional Research Laboratories authorized by Section 202 of the Agricultural Adjustment Act of 1938 are provided for the Office of Administrator cover discharging the responsibilities of the office in connection with the programs financed from these funds. Allotments formerly made to the Office of Experiment Stations for similar purposes have been discontinued. Since the Special Research Fund regional laboratory for research into the relation of soils to plant, animal, and human nutrition is under the direct supervision of the Agricultural Research Administrator, the funds for this activity are included with those allotted from the Special Research Fund to the Office of Administrator.

Report of Progress: Since the establishment of the Agricultural Research Administration, major emphasis has been placed upon the redirection and coordination of research in support of the war effort. Special attention has been given such activities as those relating to rubber; the dehydration of fruits, vegetables and meat; crop studies in support of production goals, particularly those involving the production of vegetable oils, starches, and special fibers; control of diseases and insects affecting plants needed in the war effort, including the development of readily accessible sources of materials used in insecticides; and other problems involved in meeting the requirements of the War and Navy Departments, the War Production Board, the Board of Economic Warfare, and other agencies. Progress in these and other activities is reflected in the statements pertinent to the work of the constituent agencies. Considerable attention has been given, also, to reviewing all of the research projects of the constituent agencies to provide the most efficient use of research funds and the closest possible coordination of research work.

SUPPLEMENTAL FUNDS

Direct Allotments

Project	Obligations, 1942	Estimated Obligations, 1943	Estimated Obligations, 1944
Emergency Fund for the President, national defense (Allotment to Agriculture): Emergency meat dehydration investigations	\$15,932 a/	\$188,068	- -
Regional Research Laboratories:			
Planning and coordination of the programs of the regional research laboratories authorized by Sec. 202 of the Agricultural Adjustment Act of 1938	1,823 a/	24,895	\$24,895
Special Research Fund:			
Administration, including planning, programming and coordination of special research projects	- -	15,730	15,730
Administration, including planning, programming and coordination of special research regional laboratory projects .	- -	4,770	4,770
Regional laboratory for research into the relation of soils to plant, animal, and human nutrition	100,491	98,578	98,578
Total, Special Research Fund	100,491	119,078	119,078
TOTAL, SUPPLEMENTAL FUNDS (Direct allotments)	118,246	332,041	143,973

a/ Part-year basis.

AGRICULTURAL RESEARCH ADMINISTRATION

SPECIAL RESEARCH FUND, DEPARTMENT OF AGRICULTURE

Appropriation Act, 1943	\$1,150,000
Budget estimate, 1944	<u>1,147,086</u>
Decrease (travel funds returned to surplus)	<u><u>-2,914</u></u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Administration of payments to States under Title I.				
Bankhead-Jones Act	\$24,709	\$23,000	\$22,941	-\$59
2. Special research projects	462,944	425,066	425,125	+59
3. Special research labora- tories in major agricultur- al regions	693,892	697,100	697,100	- -
Covered into Treasury in ac- cordance with Public Law 674	- -	2,914	- -	-2,914
Unobligated balance	22,835	- -	- -	- -
Total available	1,204,380	1,148,080	1,145,166	-2,914
Transfer as shown in Budget schedule	+1,920	+1,920	+1,920	- -
Total estimate or appro- priation	1,206,300	1,150,000	1,147,086	-2,914

INCREASES OR DECREASES

The net decrease of \$2,914 in this item for 1944 consists of a decrease in travel funds (returned to surplus in 1943).

The differences in amounts between projects, which offset each other, is explained as follows:

(1) A decrease of \$59 under the project "Administration of payments to state under Title I, Bankhead-Jones Act." The Bankhead-Jones Act, as interpreted by the Comptroller General, limits the amount for the administration of the Bankhead-Jones payments for state agricultural experiment stations to 2 per cent of the appropriation for the Special Research Fund. Since the estimate for this appropriation is reduced by \$2,914 because of a decrease in travel funds, a proportionate reduction is made in the amount available for administration of payments to states.

(2) An increase of \$59 under the item "Special research projects" made available by the corresponding reduction in the amount for administration of the Bankhead-Jones payments for state agricultural experiment stations.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item which consists of the deletion of the proviso at the end of the language reading as follows:

[Provided, That not more than \$5,000 of this appropriation shall be used to further the chemical phases of the soybean investigations, except the routine analytical work for plant production, now being conducted at Urbana, Illinois, and such \$5,000 shall be available only for the expenses incident to the transfer of such investigations to Peoria, Illinois, for absorption by the Northern Regional Research Laboratory.]

This change eliminates the provision inserted in the Department of Agriculture Appropriation Act, 1943, covering transfer of the chemical phases of the soybean investigations from the Special Research Fund Soybean Laboratory, Urbana, Illinois, to the Northern Regional Research Laboratory, at Peoria, Illinois, as this transfer has been completed.

WORK UNDER THIS APPROPRIATION

General: Section 4, Title I, of the Bankhead-Jones Act (approved June 29, 1935) provides that 40 percent of the funds appropriated in any one fiscal year pursuant to that Title shall constitute the "Special research fund, Department of Agriculture", and shall be available for (1) administration of the provisions of the Act authorizing payments to States, Hawaii, Alaska, and Puerto Rico for research to be conducted by agricultural experiment stations; (2) special research projects approved by the Secretary of Agriculture and conducted by such agencies of the Department of Agriculture as the Secretary may designate or establish; and (3) the establishment and maintenance of research laboratories and facilities in major agricultural regions of the United States and the prosecution of research at such laboratories. Section 1 of the Act specifies that the work conducted under the Special Research Fund shall be "research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and by-products and manufactures thereof; and research relating to the conservation, development, and use of land and water resources for agricultural purposes."

The actual and estimated appropriations and the authorized appropriations under Title I of the Bankhead-Jones Act for the Special Research Fund since its establishment are as follows:

Year	Appropriated				Authorized	
	Administration: of Bankhead- Jones payment: to states	Special research projects	Regional laboratories	Total	Total	
1936	\$8,000	\$192,000	\$200,000	\$400,000	\$400,000	
1937	16,000	384,000	400,000	800,000	800,000	
1938	24,000	576,000	600,000	1,200,000	1,200,000	
1939	28,000	672,000	700,000	1,400,000	1,600,000	
1940	28,000	672,000	700,000	1,400,000	2,000,000	
1941	28,000	672,000	700,000	1,400,000	2,000,000	
1942	24,769	480,003	701,528	1,206,300	2,000,000	
1943	23,000	427,000	700,000	1,200,000	2,000,000	
1944 (est.)	22,941	427,045	697,100	1,147,086	2,000,000	

The amount authorized, according to the terms of the Act, is distributed on the basis of 2 percent for the administration of Bankhead-Jones payments to states, 48 percent for special research projects, and 50 percent for regional laboratories. This percentage distribution was followed in the appropriation until the fiscal year 1942 when the appropriation for the Special Research Fund was reduced. Since that time, in accordance with a proviso in the appropriation act, the amount for regional laboratories has been maintained at approximately the same amount provided since the fiscal year 1939.

Administration of payments to State under Title I, Bankhead-Jones Act:

Objective: The administration of the provisions of the Bankhead-Jones Act of June 29, 1935, which authorizes Federal-grant funds for the States, Hawaii, Alaska, and Puerto Rico for agricultural experiment stations and which requires that an equal amount be furnished by the various States, Territories, and Puerto Rico.

The Problem and its Significance: The administration of these payments to states, now amounting to \$2,463,708, is similar to the administration of the payments for state agricultural experiment stations provided by the Hatch, Adams and Purnell Acts discussed under the Office of Experiment Stations. The administration of the payments authorized by the Bankhead-Jones Act differs, however, from administration of the other Acts providing Federal grants for agricultural experiment stations on a number of points, including the following:

- (1) The Bankhead-Jones allotments may not be made to any State, Territory, or Puerto Rico unless offset by at least an equal amount of non-Federal funds for research and facilities for research. This requires the review of the work and expenditures under \$2,463,708 offset funds as well as those under \$2,463,708 Bankhead-Jones Federal-grant funds.

(2) The Bankhead-Jones funds for the state agricultural experiment stations are apportioned primarily on the basis of rural population. The Federal-grant funds of these stations provided by previous Acts are on the basis of an equal amount for each state.

(3) As a part of their research offset, the States, Territories, and Puerto Rico may include expenditures during the year for physical plant and equipment necessary for the prosecution of research. This provision requires administrative responsibility to ascertain that expenditures for physical plant and equipment advanced for offset credit are for research purposes.

(4) Under the terms of the Bankhead-Jones Act the funds authorized by the Act may be used for physical plant, including the purchase and rental of land and construction of buildings and for the equipment and maintenance of such buildings without limitation as to the portion of the funds which may be used for these purposes. The expenditures, however, must be limited to those necessary for the research under this Act. It is an administrative responsibility, therefore, to approve such expenditures only in relation to the specific needs of the work conducted under the Bankhead-Jones grant funds.

The Office of Experiment Stations is charged with the administration of the payments to states authorized by Title I of the Bankhead-Jones Act of June 29, 1935.

Authorization: The Bankhead-Jones Act of June 29, 1935, was enacted with the understanding on the part of the Department, land-grant institutions, and the committees of Congress that 2 per centum of the annual appropriation under Title I of the Act would be needed to provide the administrative services necessary to make the legislation most effective. By ruling of the Comptroller General after the passage of the Act, the amount available for administration of the payments to states was limited to 2 per centum of the Special Research Fund, which is only 0.8 per centum of the total authorized by Title I of the Bankhead-Jones Act.

A further complication in this situation is that Title I of the Bankhead-Jones Act provides that 60 percent of the funds appropriated shall be for grants to states and 40 percent for the Special Research Fund. The appropriations, being separate items, have not always been made in this ratio. Since the fiscal year 1940, the appropriations under Title I of the Bankhead-Jones Act have been made on the basis of more than 60 percent for grants to states and less than 40 percent for the Special Research Fund. The amount for administration is now less than one-half of one percent of the \$2,463,708 Federal-grant and \$2,463,708 State offset funds to be administered.

Progress: During the fiscal year 1942, the administration of the provisions of Title I of the Bankhead-Jones Act of June 29, 1935, which authorized payments for agricultural experiment stations, involved:

(a) Critical examination and approval, in advance of the expenditure of funds, of research projects, there being 1,145 active Bankhead-Jones projects during the fiscal year, of which 247 were either new or revised. This represents a ten percent increase in the total number of active projects and a 33 percent increase in the number of new and revised projects over the previous fiscal year, caused largely by the effort on the part of the agricultural experiment stations to redirect their research activities toward work of more vital importance to the war effort.

(b) Review in the field of the work and expenditures at the state agricultural experiment stations under funds totaling \$2,463,708 provided under Title I of the Bankhead-Jones Act and apportioned primarily on the basis of rural population.

(c) Review in the field of research and research facilities of the stations supported by \$2,463,708 from non-Federal sources advanced as offset credit to meet the requirements of Section 5 of the Bankhead-Jones Act.

(d) Special examination of any expenditures from the allotments under the Bankhead-Jones Act made for the construction, equipment, and maintenance of buildings and purchase and rental of land to ascertain that such expenditures were necessary for the research supported by the funds provided by the Bankhead-Jones Act.

(e) Assisting in coordinating the research under this Federal-grant fund between the state stations and with the research of the Department, and maintaining advisory relations with the state stations on technical and administrative matters pertaining to their research programs and station organization.

(f) Reporting to the Secretary and the Congress on the work and expenditures under this Federal-grant fund.

Specific examples of the type of work done under this project are given below in the statement for the Office of Experiment Stations under the appropriation "Payments to States, Hawaii, Alaska, and Puerto Rico for Agricultural Experiment Stations" and under the subappropriation "Administration of grant and coordination of research with States".

Special Research Projects:

Objective: The purpose of this project is to make provision for special agricultural research--primarily "into laws and principles underlying basic problems of agriculture in its broadest aspects."

The Problem and its Significance: Part of the Special Research Fund (approximately 37 percent on the basis of the 1943 estimates) is available to the Secretary of Agriculture for special research projects. This part of the fund was intended primarily to enable the Secretary to undertake studies which are basic to agriculture in its broadest aspects and which may be

conducted by such agencies of the Department as he may designate or establish. The act requires that the research under this fund "shall be in addition to research provided for under existing law (but both activities shall be coordinated as far as possible)." There are many problems which arise, the solution of which requires research of fundamental character in order that further progress may be made. The fund enables the Secretary to undertake such work as the need arises, within the limitation of funds available.

Plan of Work: In administering, budgeting, and using the Special Research Fund no money is allotted to the bureaus which conduct the research until carefully written project plans and cooperation are outlined in detail and approved by the Secretary. Allotments are adjusted on the basis of changes in relative needs of the projects which are under way. Effort is made to retain a small part of the fund unallotted to specific projects to provide for unforeseen needs and, within the limits of the funds available, for research on emergency problems that may arise.

Examples of Progress and Current Program: During the seven years that the Special Research Fund has been available, 89 separate research projects have been undertaken and 57, constituting 63 percent, have been terminated. Of those terminated, 36 were relatively short-time studies designed to provide information for immediate needs. Of the other 21 projects, 9 were terminated in 3 years, 5 in 4 years, 2 in 5 years, 2 in 6 years, and 3 in 7 years. A total of 32 projects, involving 9 bureaus, are now under way.

The majority of these 32 projects are concerned with fields of work basic to agriculture in its broadest aspects. Many are supplying results especially valuable in the war effort. As the work progresses and as the needs vary, changes in emphasis are made from year to year. With the completion of work on one phase of a problem, the attack may be directed to another phase requiring solution.

The following are examples of progress made in special research projects during the fiscal year 1942:

Interregional Competition in the Production and Sale of Farm Products: This project was originally initiated with a view to facilitating peacetime adjustments in the regional pattern of American agriculture. The present national emergency with its war production goals for agriculture requires a far-reaching rearrangement of the immediate pattern of regional production and this rearrangement is bound to have important post-war effects. In addition to the necessary internal adjustments, the maximum contribution to the war effort requires that special attention be given to close economic collaboration and interregional adjustments among the United Nations.

A preliminary confidential report of the regional pattern of American agriculture was prepared at the request of the National Resources Planning Board. This report shows for major crops and livestock products the estimated regional distribution for 1944 (peak of the war effort) and 1954 (after the immediate post-war adjustment). To cite one example of situations being studied,

the enormous increase in peanut acreage now under way is likely to establish a farm enterprise in the South that will greatly change the post-war pattern in that region.

The recommendations of the Joint Economic Committee of the United States and Canada, based in substantial part on analysis of the feed grain and fats and oil situation for North America, have resulted in specific action on the part of the governments of both countries. The actions have provided for an increase in feed grain acreage in Canada to offset reduction in feed grain acreage in the United States made necessary by the increase in acreage of oil crops, especially soybeans. An analysis has been completed of the regional location of potato production in the United States and Canada. This analysis indicates that the North American food position can be improved by expansion in Canadian potato production to offset partially an expected contraction of potato production in the United States caused by expansion of other vital war crops.

Earlier findings in this study have been applied in the job of distributing the national 1942 goal for milk production and in estimating probable responses to be expected in different regions. An analysis of selected areas in the Lake States was especially helpful in indicating the need for unusually strong incentives to obtain the necessary increases in milk production.

A special report was prepared at the request of the National Resources Planning Board to serve as a part of a general report on industrial location. Agricultural materials enter into so many manufacturing processes that the effect of their location on the location of processing industries is greater than is commonly supposed. About 43 percent of all workers employed in manufacturing in 1937 were in industries engaged in processing farm and forest products. In a substantial portion of these industries, agricultural considerations were dominant in determining their location. Because of the rapid rate of technological change in the processing of many agricultural commodities, due to the war effort, both in current and post-war industrial planning must take special account of agricultural considerations.

Long-Range Weather Forecasts: The present war, to a considerable extent, is being waged in foreign regions where no well-organized network of weather stations is available for the preparation of weather maps and the making of forecasts of local weather conditions. This investigation was undertaken in cooperation with the University of Chicago to develop methods for making both short-period and extended forecasts of weather from a very limited network of weather observations or from surface and upper air observations at the point where the weather forecaster is located.

Special upper air observations taken at Fairbanks, Alaska, and Fort Smith, Canada, materially increased the knowledge of the atmospheric circulation in Alaska and northwestern Canada. This information has been extremely useful to the Army in planning airway routes through Canada and Alaska for the Ferry Command and other military air transport. The knowledge obtained from these studies is applicable to northern Siberia and other polar regions.

A critical survey of all alleged methods of long-range weather forecasting prepared the way for the present Army-Navy-Weather Bureau program for developing methods of making extended weather forecasts--extended in time and in space. "Spot forecasting" was developed during the year to meet the needs of the Army and Navy in making short and long-range forecasts for military purposes. For this method weather observations are made "on the spot" or from a very limited network of observations.

Systematic analyses of a circulation of the atmosphere over North America and Alaska based on daily data from these regions have been carried out at the University of Chicago. Charts constructed for the ten, thirteen, and sixteen kilometer levels above the earth's surface reveal a close relationship between the circulation at the very high levels in the atmosphere and the circulation in the lower, weather-producing levels of the atmosphere. These observations will be used in developing methods for making longer range weather forecasts by the Army-Navy-Weather Bureau Central. Techniques being used by the armed forces cannot be discussed here in detail.

Plant Growth Substances (Plant Hormones) in Relationship to Plant Production: Plant hormones are now regularly used by nurserymen, orchardists, and other persons working with plants to produce certain reactions in the plants. The object of this investigation is to test and determine the effects of natural and synthetic substances, known as plant hormones, on all phases of plant development and behavior.

Plants sprayed with various substances may become taller than those not sprayed. One such substance, an ether extract of hickory pollen, stimulated stem elongation. On the other hand, extracts from pine and walnut pollen were inactive. Other substances sprayed on plants resulted in a stunting and greatly increased woodiness of the plant. This finding may have practical significance in bringing about thickening of the leaves of leafy vegetables and stiffening the stems of plants which tend to be weak. Branches of trees with proper treatment may be made to assume desired positions and thus strengthen the whole structure of the tree.

Several growth-regulating chemicals retarded the growth of foliage buds. These chemicals, however, failed to delay the date of blooming of the peach and the pear in a manner that insured against frost injury. As a result of various treatments, it was possible to increase or decrease the rate of bud development and opening of the flowers when fruit trees were sprayed with plant hormones. If sprayed when the buds were near blooming, however, the rate of opening was increased.

Certain plant hormones have been found to prevent shattering of the seed of plants near or at time of maturity. One large producer of seeds is using sprays for this purpose before harvest. Commercial companies are experimenting with methods of spraying sugar beets to increase set of seed and prevent shattering.

A method has been devised for estimating the amount of plant growth substance

in soils. Some evidence was obtained to show that a high nitrogen level in the soil was conducive to high hormone development in plants. This finding will, no doubt, lead to more exact studies of the relationship between growth substances and soil fertility.

Extensive investigations are being made on the practical usefulness of growth-regulating substances in crop production. For example, it was found that vaporous naphthoxyacetic acid stimulated the development of tomato fruit. This finding indicates the possibility of developing fumigation methods for controlling certain kinds of fruit development. Treatment of soils and seeds with dusts or sprays may be of significance in obtaining greater yields of crops. The fact that many of these compounds are severely toxic to plants even in very great dilution may offer a means of decreasing undesirable crop production in special cases. Similarly, these sprays may be developed for controlling weeds with little or no apparent injury of the soil. Sprays now used for weed control usually make soils toxic for plant growth for an appreciable length of time.

The Effect of Light and Environment Upon the Growth and Development of Plants: Seasonal range in day length, varying from the short days of winter to the long days of summer, is known to be important in controlling the growth and fruiting of plants. This investigation has concerned itself with determining the changes that occur in plants as the exposure to daylight is increased or decreased.

The results of this research point to the desirability of selecting varieties of commercial crops best adapted to any particular locality. For example, the soybean variety, Biloxi, which flowers only on relatively short days, is too late a bloomer to produce seed crops in the north. However, there are many other varieties which set flowers and seeds on much longer days, which means that they flower sufficiently early in the summer to mature a seed crop before fall frosts. It now seems entirely feasible to determine experimentally the length-of-day and temperature responses of any variety of plant, and to base specific recommendations for plantings large areas on these findings.

By critical selection of localities where the length of day and winter temperatures are in adjustment to the requirements of specific strains of sugar beets, it has been possible to raise better seed and very much larger quantities of it in a single year than was previously possible over a period of two years. This finding is now being used as a basis for selecting sites for the production of seed of several kinds of plants such as table beets, carrots, cabbage, and others which generally require two years to produce crops of seed.

It has been ascertained that both winter and spring varieties of barley require long periods of daylight to head and produce seed. For forage purposes greater development can be expected where growth may occur during the period of the year when the days are short. In addition, winter varieties must be subjected to periods of low temperature in order to produce seed. For successful commercial production of grain, winter varieties can be grown only in those localities where they receive such a period of low temperature, whereas spring varieties can be grown over a much wider range.

Studies with plants raised from mixed seeds of several species of native range grasses, which extend from Arizona to Montana, indicate clearly that among those obtained in Arizona there are many more individuals of the short-day type than among those from Montana. More of the plants from Montana responded to relatively low temperatures in making greater vegetative growth than did the plants from Arizona. This finding is significant in relation to range pasture management and the possible use of seed from one region in another having different climatic and light conditions.

To meet the increasing demands of the United Nations for vegetable seeds, the relation of day length and temperature is being studied for a wide range of crops, especially biennials. It is the object of this study to define the conditions necessary for the production of seed supplies in as short a time as possible.

Effect of Artificial Control Practices on Natural Enemies of Insect Pests:

Annual crop losses in the United States due to insect attack amount to approximately two billion dollars, and more than twenty million dollars are spent for insecticides each year. The application of these insecticides kills not only the pest but often its natural enemies as well. These parasites and predators are very important aids in holding many pests in check and, if they are eliminated, the problem of control may become much more difficult. Effective imported parasites may be prevented from attaining full effectiveness if certain spray programs are continued. This investigation was undertaken to obtain basic data which may determine the effect that various recommended practices for insect control will have on the natural enemies.

It has been believed that the heavy pest infestations that followed the application of fungicides for control of citrus diseases were due to elimination of the parasitic fungi that normally control the pests. In this project it was demonstrated that purple scale infestations were due to the granular residue left on the foliage by the sprays used. This residue apparently provided exceptionally good physical conditions for the young scale and, consequently, a high proportion of them survived. The problem was solved by the use of fungicides that do not leave a granular residue, and the scale problem does not now complicate or follow disease control. This solution also made possible a substantial saving in spray materials.

Granular residues from sprays applied against other insects were found to cause increased infestations of the citrus mite in California. These infestations may be avoided by using sprays that do not leave such a residue. It was found that all sprays containing zinc induced development of exceptionally heavy infestations. Evidence was accumulated to show that residues are responsible for increased infestations of many insects, especially mites, scale insects, aphids, and white flies. This discovery, with its simple solution, is an outstanding contribution.

Tests were made with several insecticides used in California to determine their effect upon insect parasites. Tartar emetic, used extensively for thrip control, is, in its liquid state, very toxic to parasites but after drying was so

unattractive that it caused only slight mortality to scale insect parasites in the field. Insecticidal dusts, even if inert, often caused a high mortality among parasites. This situation was found to be directly correlated with particle size, only the very fine dusts causing high mortality. Mealybug infestations could not be quickly controlled by the effective predator, *Cryptolaemus*, if the trees were dusted with cryolite for control of orange tortrix. Oil sprays were much less destructive to the immature stages of parasites of the black scale than cyanide fumigation.

In West Virginia the application of even 5 to 7 or more cover sprays for the control of codling moth was followed by as high as 50% wormy fruit. When all cover sprays were discontinued in an experimental orchard from 1937 to 1940, 37.6% of the fruit produced was clean, as compared with 67.6% from an orchard receiving the full spray program. On a net basis, money returns to the growers were very nearly equal from the two orchards. The results indicate that in certain sections fair crops of clean apples can be produced without spraying if the orchard is otherwise properly cared for. This practice is particularly applicable to home orchards, especially in view of the probable shortage of spray materials.

Flue-Curing of Tobacco: Although curing is a controlling factor in determining the quality of tobacco, there has been no exact information as to the conditions required for best results. Methods of controlling temperature and humidity in present structures used for curing are inadequate and, at best, satisfactory results are now obtained only by close expert supervision day and night throughout the operation. This factor is a very important consideration with present farm labor shortages. Lack of flexible control systems has made it almost impossible to properly adjust the conditions in barns now used to meet varying requirements for different lots of tobacco. Improper adjustment has been responsible for many failures in curing, with a loss to growers estimated at 5 million dollars annually.

The temperature and humidity requirements, at the different stages of curing, for obtaining flue-cured tobacco of high quality have been fairly well determined for the first time. In most curing barns wide variations in temperature and humidity were found in different parts of the barn. This condition could be corrected by means of forced air circulation and more efficient ventilation.

The use of somewhat higher initial yellowing and drying temperatures materially improved the market value of the crop as compared with present practices. Increased ventilation in the earlier stages of curing also improved the quality of flue-cured tobacco. It was found that contrary to the more usual practice, leaf which is somewhat overripe should not be cured with tobacco which has just reached maturity. The conditions for obtaining good color at the two states of maturity are different. It has been demonstrated that, as compared with most present curing barns, structures of tighter construction, preferably insulated, and more adequately ventilated give better results and also conserve fuel.

It has been discovered that high-grade, flue-cured tobacco has a very high

content of sugar. One of the principal results of proper curing is to convert the starch content of the green leaf partly into cane sugar and partly into invert sugar. The best qualities of the leaf are not fully brought out until the cane sugar is more completely changed to invert sugar, which serves to improve the texture, body, and flexibility of the leaf. This latter change takes place when the cured leaf is bulked down in the pack house before grading. A crop taken directly from the curing barn to the market, as is often done, is sold at a disadvantage to the producer because it has not acquired its best appearance and quality.

Blue Mold Disease of Tobacco and Its Control: This disease is a universal and constant crop hazard for tobacco growers, particularly in the Southeast. It delays planting, destroys plants, and makes it necessary for growers to have plant beds at least three times as large as would be required if blue mold were completely controlled. It is estimated that the cost of increased size of plant beds amounts to 5 million dollars annually. Indirectly, through its destructive action on the seedlings, the disease seriously reduces the yield and quality of the crop.

Two reasonably satisfactory methods of control have been developed and made available to farmers. In one method a copper oxide-oil spray is used as a preventive and is applied to the young plants prior to the development of the disease. The other method consists of a paradichlorobenzene gas treatment which is effective in stopping the disease after it has developed. Both of these methods require materials that are now needed for the war effort.

During the past year experiments were conducted with organic fungicides made of materials not at present required for war uses. Several salicylates, especially bismuth subsalicylate and benzyl salicylate, have given most promising results. These organic fungicides can apparently be substituted for the copper oxide, they are simpler to use, and appear to be more effective in controlling blue mold.

Blue mold overwinters in tobacco plant bed soil, and when a bed area is used the second year, the disease often strikes early and severely. If the disease could be eliminated from the soil it would be an important aid in control. Investigations have indicated that treatments of the soil with such substances as cyanamide, chloropicrin, and urea eliminate blue mold infection. However, since all of these materials are needed in the war effort, tests are in progress to determine the effectiveness of other materials that are available.

Varieties of tobacco resistant to the disease offer the best ultimate solution to the blue mold problem. Some of the wild tobaccos proved to be highly resistant to blue mold. Several of these wild types have been successfully crossed with the cultivated tobacco. Resistant plants have been selected and backcrossed to the cultivated parents. It is anticipated that within a relatively short time, resistant lines sufficiently advanced for plant bed and field trial will be established, and that commercial types resistant to blue mold will be obtained.

Climatic Adaptability of Plants: This investigation was undertaken to show the relation between the growth habits and climatic adaptation of a plant species in one locality and what may be expected of this species when it is transported to a new locality.

War developments have placed cork from the cork oak of the Mediterranean in the class of strategic material. The tree was introduced into the United States about 30 years ago, but was generally reported a failure. A bioclimatic study of the requirements of the species disclosed sections of the country other than the scattered localities in which individual specimens survived in which the possibilities of successfully growing cork oak with high bark yields were good. In these areas plans are now being developed for large-scale planting by cork-using companies and by the Forest Service and Soil Conservation Service. A comparable study of the Latin Americas was also made to determine bioclimatically whether there were opportunities there for producing the trees. Parts of Mexico and the great valley of Chile appear to afford the best possibilities.

Many other plants economically important for food, fiber, or medicine should be similarly investigated, as a part of the war effort, to provide maximum opportunities for the successful introduction of needed plants. A current study of guayule covering both this country and South America is being made to determine where this native plant might be grown more extensively and at the same time maintain a high latex content. Plants from certain areas have a high latex content, while in plants from other areas the latex content was low, even under natural conditions. Both low winter temperatures and high summer temperatures appear to influence the latex production of this species. These observations demonstrate the need for careful selection of site in establishing this important source of critical material.

The bioclimatic study of the southern pines suggests that the slash pine might be a relative newcomer to America, making its way westward along the Gulf Coast and northward along the Atlantic Coast. So far it has not crossed the Mississippi, but bioclimatically there appears to be no reason why it should not go farther north and west. On the basis of similar studies, the southward march of loblolly pine throughout the range of the longleaf pine is forecast. If not checked by forestry practices, southern forest economy will be deeply affected.

The Chemistry of Enzymes: This investigation was designed to ascertain the chemical changes produced by enzymes that cause the deterioration of agricultural products and to devise means for controlling these changes.

High moisture wheat stored at Manhattan, Kansas, spoiled through bin burning in 10 days. Similar grain treated with ethylene gas baked good bread after 10 months' storage. The cost of the treatment, exclusive of a small labor charge, was less than 0.001 cent per bushel. The fire underwriters apparently are convinced that the process is safe. The Millers' National Federation has asked that an experiment be run on a large quantity of wheat in a commercial elevator.

Shelled corn treated with ethylene at Ames, Iowa, failed to respond as did wheat at the concentration of gas used. On the other hand, there was less bin

burning of shelled corn when treated with carbon dioxide gas than normally occurred. In two tests, bins of hot corn were materially cooled down by carbon dioxide treatment. Studies are being continued to determine the most effective method of applying the gas.

The digestion of the connective tissues of meat by papain is known as "tenderizing." Papain is a substance derived from the papaya. The tenderizing process was studied to determine the changes that occurred during the treatment. In connection with this study a process was developed for making a specially active papain that would keep indefinitely. A patent was granted for the process during the year, and an enzyme manufacturer has received a license to manufacture the product.

Later studies with papain showed that under proper conditions meat treated with the product quickly liquefied. This liquefied meat may be dried to a powder containing the flavor and food value of the original meat. The preparation also may be easily sterilized, a decided advantage. Powdered dehydrated meat has not met with particular favor by consumers. However, for preserving such meat products as liver, which is extremely valuable nutritionally but very difficult to keep, the process has considerable merit.

Farm Storage of Corn: The major portion of every corn crop is stored and consumed on the farm. Although farm storage has been practiced for years in the Corn Belt, many problems connected with safe storage are not fully understood, especially in connection with maintaining the soundness of corn for more than one year. More information is needed concerning the difficulties encountered from stored grain insects in different areas and the most efficient methods for preventing or controlling these pests by modification of storage conditions or by treatment.

Observations on the drying and conditioning of ear corn in cribs in Illinois and Indiana showed that the average moisture content in samples was approximately 12 percent in July as compared with 14 percent the previous April. No material increase in damage by mold or rodents had occurred during this period and few insects were observed. Corn in single cribs not more than 8 feet wide and exposed to drying winds was in the soundest condition, while corn in circular and octagonal cribs 14 to 16 feet in diameter was the most severely damaged. The rate of drying or the amount of moisture taken up by corn in the crib is apparently related to the size and shape of the storage structure.

Shelled corn stored in steel bins showed the greatest damage in the center of the bin in the upper one foot layer, largely because of an increase in moisture content of 5 to 8 percent during the fall and winter. Although this portion dried out again with the coming of warm weather in the spring, some damage to the corn took place. Appreciable spoilage occurs in certain areas at the junction of the wall and floor of the bin where there is an opportunity for moisture to gain entrance either as liquid moisture or as damp air. A special flange has been developed which largely overcomes this design defect.

Insect control is necessary for the successful storage of shelled corn in steel bins. The addition of 10 percent methyl bromide to the standard ethylene

dichloride-carbon tetrachloride mixture has resulted in a more efficient fumigant, which has been put into use. Experiments are being conducted on the temperature and moisture requirements of insects to ascertain whether storage conditions may be modified to aid in controlling these insects.

Special Research Laboratories in Major Agricultural Regions:

Nine regional laboratories have been established under the provisions of Sections 1 and 4 of the Bankhead-Jones Act of June 29, 1935, to provide a joint Department and state experiment station attack on problems of regional or national scope. These regional laboratories, which were established and are conducted in each case with the cooperation and participation of the state agricultural experiment stations in the respective regions, serve as focal centers for regional coordination and cooperation of research in the subjects under study by the laboratories. The work of the laboratories is centered especially upon phases of the problem under study which would be difficult or impossible for an individual state or a group of states to undertake.

Examples of Progress and Current Program: As indicated below the work of the laboratories is furnishing data helpful to the war effort. The following are examples of the progress made and work being conducted at each of these laboratories during the past fiscal year:

Laboratory for Research Into the Heredity and Behavior of Vegetable Crop Plants for the Development of Improved Varieties Having Superior Adaptation to the Southeastern Region of the United States: (Approved by the Secretary, November 30, 1935: located at Charleston, South Carolina). The southeastern region is a potential source of increased foodstuffs needed for the Food for Freedom goal. Climatic conditions are both favorable and unfavorable for the production of vegetables. The long growing season makes possible the growing of a wide variety of crops. On the other hand, the temperature and humidity conditions also encourage diseases and insects, two very important factors handicapping production of high-quality products at a reasonable cost. The laboratory program aims to develop new varieties of vegetables better adapted than any now available to conditions in the region. Improved commercial varieties and varieties adapted for home gardens will result not only in an increased income for producers but will also improve the general health and well-being of the populace of the South and Southeast.

As a result of the laboratory breeding program basic stocks of two newly developed bean varieties, Cooper Wax and Ashley Wax, for use as shipping and canning beans, respectively, have been released to cooperating state agricultural experiment stations and to many commercial seed growers. These varieties are resistant to common bean mosaic, tolerant to powdery mildew, and sufficiently leafy so that damage from bacterial blights tends to be minimized. The pods of both varieties tend to be free from blemishes. In addition, these beans produce at least a normal crop under good conditions and a fair crop when conditions are such that varieties in present use would not be planted. While wax varieties have not been popular in the South, records

show that wax pods average a moderate premium over green pods in both shipping and canning types.

A small podded, high quality, early strain of peas will be released to the co-operating experiment stations and seedsmen this fall, if a satisfactory increase is obtained in present plantings. This strain showed cold tolerance last winter approaching that of Austrian Winter peas. Peas generally have given low yields in the South, chiefly because the weather warms up so quickly in the spring that even early varieties are seriously injured by the hot weather. If planted to mature earlier the ordinary varieties were usually damaged by frost and as a result were delayed in maturing or suffered reduced yield and lowered quality. The new strain planted at Charleston on December 1 last fall came through very cold weather with little damage to leaves and stems and produced a crop before heat damage was extensive in the spring.

Tests with summer cabbage planted in the field in May and June at the laboratory showed that the Volga variety produced a satisfactory proportion of heads in July and August when such varieties as Chieftain Savoy and Charleston Wakefield produced none. There were indications that selection within the Volga variety will produce a summer garden type. This type, furthermore, holds promise of requiring no more dusting with insecticides than that given fall-grown cabbages. Preliminary tests on certain of these selections have given ascorbic acid (vitamin C) readings which were higher than readings obtained from Volga in the fall and spring. The readings, however, were not as high as those obtained with the varieties Midseason Market or Marion Market in northern cabbage districts during July.

The work of the laboratory on the problem of multiple disease resistance in tomatoes has reached the place where breeding material is available that is resistant to five major diseases occurring in the South. When multiple resistance is combined with desirable horticultural characteristics, southern growers will have tomatoes that should bear over a much longer season.

Studies of the ascorbic acid (vitamin C) content of vegetables have been actively pursued by the laboratory this year. It now seems possible to produce horticulturally desirable strains of tomatoes, cabbage and snap beans with considerably greater ascorbic acid content than varieties now available. It has been fully demonstrated by the laboratory that ascorbic acid content, although it varies with stage of maturity and in some cases with size or other characteristics, is relatively much less variable than yield. There are also many indications that the content of ascorbic acid is hereditary. The laboratory has developed chemical techniques for determining ascorbic acid content that are especially adapted to the plant breeding and genetic studies.

The war has intensified the need for canning in the South, especially for canning the surplus peaches. Peaches alone do not justify a canning factory but with other items added the season could be lengthened to make the enterprise profitable. The laboratory has suggested a canning schedule for South Carolina consisting of: Asparagus, peas, snap beans, tomatoes, peaches, snap beans, and peas. This schedule gives a very long season from spring to fall. It has in

part been made possible by improved varieties developed by the laboratory and the Bureau of Plant Industry. A canning schedule of this kind also would be applicable in other parts of the South.

Laboratory for Research Into Laws and Principles Underlying Pasture Improvement in the Northeastern Region of the United States: (Approved by the Secretary, February 20, 1936; located at State College, Pennsylvania). The Northeastern States form the great market milk region of the United States. In any dairy program pastures afford the cheapest source of feed and produce the most profitable returns of all the available feeding stuffs used for the maintenance of animals. The importance of maintaining a milk supply in line with increased war requirements and market demands in this region necessitates an abundant supply of low-cost feed as a means of economical production. In recent years milk production in the region has been inadequate due chiefly to normally low feed supplies, a generally short pasture season, and a low carrying capacity of existing pastures. Pasture improvement is essential, therefore, to agricultural betterment in the Northeastern region. Moreover, pasture improvement has a direct relation to problems involved in the control of erosion and in watershed control.

Because of the present war demands for a greater production of dairy and other livestock products, the laboratory is placing particular emphasis on the more practical phases of pasture management and the production of new strains of pasture plants. Plans have been formulated to increase strains that appear promising so that in the event they prove to be superior in further tests, sufficient seed will be on hand for distribution.

In studies with Kentucky bluegrass, 144 new strains were selected for disease resistance, vigor under grazing conditions, and uniformity. Of these, 34 have been tested in plots two or more years. Seed increase plots of five of these strains were established in the spring of 1942, and increase plots of 11 others are being established at the present time. These seed increases will be available for distribution for testing elsewhere in the region and will serve as foundation seed stocks of those strains found suitable for distribution to the farmers.

As a result of breeding white clover, one new strain is being increased and two additional strains will be ready for increase soon. Because of the increasing interest in Ladino clover in the region, the breeding program with this variety has been expanded. Superior appearing plants from commercial seed were grown in association with orchard grass in small plots. Eight of the better yielding and more persistent plants will be intercrossed in 1943 to provide seed for a new strain. Additional plant material has been collected from relatively old Ladino pastures for further breeding work.

In order to study the effect of environment on the establishment of grass seedlings, eight pasture species were grown from seed under various artificial climates in special chambers constructed for this purpose. Marked variations were shown in the ability of pasture plants to grow under widely different temperatures. Sudan grass produced four times as much dry matter at

temperatures of 70° to 85° F. as any other species used, but at 40° to 55° it was the only species which actually lost weight. Meadow fescue produced more growth than any other species at this low temperature, followed closely by brome grass and orchard grass. Temperatures of 55° to 70° were most favorable for the growth of meadow fescue, orchard grass, Kentucky bluegrass and colonial bent, whereas a range of 70° to 85° was most favorable for Sudan grass and Ladino clover. At 85° to 100° F. only Sudan grass increased in weight. Some of the other species germinated but the seedlings did not survive six weeks at these high temperatures. These results will be extremely valuable in determining the adaptation of grass species to local environmental conditions and in providing seed mixtures that will produce satisfactory grass throughout the growing season.

Studies of the effect of high soil temperatures on subsequent plant growth have been continued using different soils and incubating them under various conditions. It was found that incubating the soil at 45° C. or higher always gives poor subsequent growth of clover. In all cases the injurious effect was largely overcome by liberal applications of phosphate. The results, however, indicate that another factor or factors may contribute to the injurious effect of high soil temperatures. The solution of this phase of the laboratory program will contribute to the economic utilization of fertilizers on pastures.

Recovery of plants that have been grazed is directly related to the chemical composition of the roots. When the tops of ryegrass were removed by cutting in laboratory tests, new growth of leaves began immediately and the reserve material of the roots and stubble were drawn upon to furnish the structural material of the new leaves. The roots and stubble did not regain their original composition until about four weeks after cutting. Under the conditions of this experiment a second cutting before the expiration of the four-week period might seriously upset the equilibrium of the plant and lead to root starvation. A knowledge of the methods of management to insure adequate time for recovery of grazed pasture species will undoubtedly increase the total production of herbage during the grazing period.

The laboratory has attained some measure of success in treating Sudan grass and alfalfa seeds with protective dusts that prevent damping-off by soil-borne organisms. When this procedure has been perfected, farmers will find it possible to obtain the same stand of grass with less seed than is now being used.

Laboratory for Research Into the Industrial Utilization of the Soybean and Soybean Products in the North Central Region of the United States: (Approved by the Secretary, February 20, 1936; located at Urbana, Illinois). In order to make the best use of all resources in the war effort, growers were asked to make a 54 percent expansion of acreage in soybeans to be harvested for beans. The high oil and protein content of the beans, and their adaptation to a wide variety of industrial uses, has given this crop a place of major importance in the planning of our national food and industrial programs. The laboratory program is designed to assist the producer and industry to make the best possible use of available material and to develop new material or new methods of using it that will increase the value of this crop in our economic pattern.

As a result of the laboratory program, uniform soybean nurseries were established in cooperation with the state agricultural experiment stations in the major soybean producing States of the North Central region. Rapid progress is being made at these nurseries in evaluating the superior strains produced in the breeding program. As a result of this extensive testing of improved strains in comparison with the standard commercial varieties of soybeans, a total of four new varieties--Chief, Patoka, Boone, and Gibson--have been released to producers by cooperating experiment stations.

The breeding studies with soybeans have shown that selection from hybrid material holds promise for improvement in such agronomic characters as yield, lodging resistance, seed quality, and in chemical composition of the seed. Although, in general, hybrids tend to be intermediate between the parents in chemical composition, in many cases the hybrid is higher than the higher parent or lower than the lower parent in certain constituents. A study is being made of the manner in which such characters as percent protein, percent oil, and iodine number of the oil are inherited in order to more intelligently carry on the breeding work. The value of chemical analysis as a factor in selection of breeding material is proving its worth. On the basis of past experiences, the laboratory has determined that the analysis of selections of hybrid material will be made on a composite of at least two years' seed, in order to eliminate partially the seasonal variations in relative performance.

During the past year the laboratory has made 4,000 hand pollinations, 10,000 selections, and has 4,500 strains under trial and observation. From just such an extensive program has arisen another new strain of recognized value, which is being increased for future release. This strain is adapted to the northern part of the soybean belt. In comparison with the varieties grown in that area the new variety is higher yielding, more lodging-resistant, and contains a higher percent of oil with a higher iodine number. Based upon yield and chemical composition figures obtained during the last year, the substitution of this new strain for present varieties in its area of adaptation would make available an additional amount of several million pounds of oil annually.

Textile fibers, similar in properties to natural wool, may be made from vegetable protein, such as that formed in the soybean. Preliminary results at the laboratory have demonstrated that purified soybean protein has many qualities which would allow it to enter this field.

The drying oils used in the United States are derived to a large extent from foreign sources. Among the serious shortages of these materials at the present time are tung and perilla oils from the Orient and linseed and castor oils from South America. Soybean oil with the higher iodine numbers has the quick-drying property sought by the laboratory to replace the imported drying oils. Selective solvent extraction techniques have been developed to separate the quick-drying fractions of soybean oil. When used in the formulation of ester gum varnishes, these fractions have produced films of excellent water resistance and durability. The non-drying fraction appeared to have improved value for use as an edible oil.

The laboratory demonstrated that the addition of a small percentage of water-leached and heat-denatured soybean meal or heat-denatured soybean protein greatly increased the plastic flow, without altering appreciably the strength of the finished product, of a phenolic resin-wood flour molding powder. This molding powder is needed in preparing certain plastic items used in the manufacture of munitions.

The laboratory has cooperated with the Northern Regional Research Laboratory in demonstrating the value of soybean oil in the production of Norepol, a rubber substitute.

In accordance with the Department of Agriculture Appropriation Act, 1943, the chemical phases of the soybean laboratory investigations, with the exception of the routine chemical analyses in connection with the agronomic work, have been transferred to the Northern Regional Research Laboratory, Peoria, Illinois.

Laboratory for the Improvement of Swine Through the Application of Breeding Methods in the North Central Region: (Approved by the Secretary, December 22, 1936; located at Ames, Iowa). The call from the Federal Government for increased supplies of meat and fat brought about such a great expansion in swine production that the numbers of swine on farms in the United States are now at an all-time peak. Normally swine supply one-half of the total tonnage of meat produced in the United States. In time of war hogs must furnish more than half the meat supply, since their numbers can be increased quickly without serious dislocation of other agricultural practices. The expansion of this major agricultural enterprise emphasizes the need for improvement of the productiveness, vigor and general efficiency of the animals.

In the past, swine improvement has been brought about by conventional practices of selection based largely on the appearance of animals. Because of the low heritability of functional characters and their low relationship to appearance of the animals, conventional practices do not hold much promise for further improvement. The laboratory program provides for inbreeding to some degree in order to establish lines of stock which differ widely in their heredity.

There are being developed 40 inbred lines, each started to fix the inheritance of characters of economic importance. The breeding herds maintained at the cooperating state stations consist of 750 sows and 100 boars, representing 5 breeds and 2 crossbred foundations. A total of 936 litters was farrowed in 1941. Inbreeding in the various lines varies in degree from nearly 0 to 70 percent.

Last year it was reported that, contrary to accepted thinking, the results indicated that highly inbred lines could be developed without loss of practical merit. During the past year there have been even increases in merit and performance in some lines as the inbreeding has advanced. In general, however, there appears to be a small decrease in vigor of pigs at birth and up to about 12 to 16 weeks of age in several of the lines. In some lines there has been a definite decrease in fertility, but in others fertility has been maintained. Both rate and economy of gain are very favorable for many of the inbred lines. In comparison with the results obtained in corn breeding at a similar state the results so far obtained with swine are decidedly encouraging.

The value of an inbred line is proven when it is crossed with another inbred line or with non-inbred stock. Increased vigor, varying from a slight to a pronounced degree, has been evident this year when crosses have been made of lines within a breed. This improvement was noted even when the lines were not inbred more than 30 percent and was especially evident when the lines were not closely related themselves. Inbred boars that have been used on non-inbred stock have produced very satisfactory results.

The laboratory program includes a study of procedures which will provide more effective guides in the selection of breeding animals. One method is to obtain scores for each animal at a definite period. These scores permit a numerical appraisal of individual animals and make it possible to analyze the data on performance of the stock. To date this procedure has not given an accurate appraisal of animals, but studies are being continued to improve methods of scoring or to find a more useful means of appraising individual animals. Another method of attack on the problem of effective selection of breeding animals is to determine the value of indexes based on three or more items. At the present time an index has been developed based on growth rate, score, performance of dam, and performance of litter mates. Theoretically, the use of this index should result in an increase in weight at 180 days, in score and in productivity in succeeding generation. This index in actual use is 3 times as efficient as score alone in selection of breeding stock.

Laboratory for the Improvement of Sheep for Western Ranges Through the Application of Breeding Methods: (Approved by the Secretary, February 24, 1937; located at Dubois, Idaho). The range sheep industry of the 12 Western States that are collaborating with the laboratory involves approximately 33 million head. These animals produce annually about 275 million pounds of wool which is about two-thirds of the Nation's supply. Within this same area originates about two-thirds of the country's lamb tonnage. These sheep, together with range cattle and horses, utilize approximately 394 million acres of public and state lands, national forest and Indian reservations, together with millions of acres of privately-owned grazing lands. For wintering and fattening, sheep consume vast tonnages of roughages, concentrates, and farm by-products that are characteristic of Western agriculture and essential to its success.

The industry has suffered from lack of uniformity of product, especially of grade and quality of wool. Too many flocks throughout the region are producing wool of all the different grades. This situation results in confusion for the wool-buying trade and an important economic loss to the producer as wool of mixed grades does not command a high price. In an attempt to bring some order out of this confusion the program of the laboratory was planned to develop new strains of sheep that were more uniform and efficient in wool and lamb production than those now existing. The laboratory has made a significant advance showing how wool, the bulk of which is within one grade, can be produced on breeds adapted to range conditions. If the bulk of wool produced in an area was of one grade, the sheepmen of that area would have a distinct marketing advantage. Rams bred at the laboratory are loaned through the cooperating state stations with a view of injecting into other flocks uniformity in high wool production of the essential grade involved.

The mean staple length of fleeces produced in 1941 at the laboratory was about 2.25 inches, with a maximum of 3.25 inches. The clean wool yield of these fleeces was 41.4 percent. These figures are above the average for 12 months' production under range conditions. One bag of 30 fleeces with a staple length of 2.5 inches had a shrinkage of 3.5 percent less than had a bag of 33 fleeces of 2-inch wool. These figures show one of the advantages of producing long staple, fine wool.

As a means of concentrating the most desirable characters in the shortest possible time, the laboratory program has included inbreeding. A study of 272 yearling ewes shows that inbreeding has had some effect upon the wool and body characteristics of the animals. For each percent increase in the inbreeding coefficient there has been an average decrease of .05 pounds in fleece weight, .01 centimeters in staple length, and .37 pounds in body weight. Defects have not appeared to any significant extent in the laboratory flocks, and the vigor of the animals seems to hold up well. In an outcross involving 8 yearling ewes, whose dams were inbred 30 percent, and an unrelated ram, lambs were produced which had .4 pounds heavier fleeces than their dams and which were 3.5 pounds heavier in body weight. The outcross lambs had made a significant recovery of the loss in body and fleece weight due to inbreeding in the dams. The outcross lambs have the advantage over lambs bred in the usual manner in that they are more uniform in body conformation and in fleece characters.

As reported last year, the laboratory's selection and mating plans are directed toward removing the wool covering from the faces of Rambouillets so that wool blindness will not be a problem. In the fall of 1941, 11 percent of all Rambouillet lambs at weaning time had the open face and 40 percent had partially open faces. Open-face ewes produce annually approximately 10 percent more pounds of lamb weight at weaning time than wool-blind ewes. Skin folds in Rambouillet sheep are an annoyance in shearing, have definite disadvantages in connection with fly trouble and variability in wool, and apparently have no commercial advantage. The laboratory is making progress in the selection of smooth Rambouillets which are relatively free from skin folds on the neck and body. Sixty-six percent of the lambs were free from folds at weaning time in 1941.

Laboratory for Study of the Mechanism of Infection in the Contagious, Infectious, and Parasitic Diseases of Domestic Animals and Poultry, and Methods of Control in the Southeastern Region: (Approved by the Secretary, February 24, 1937; located at Auburn, Alabama). Livestock production in the Southeast has long been handicapped by the diseases and parasites that attack these animals. Climatic conditions, such as long summers and absence of prolonged cold periods, are favorable to the persistence of diseases and parasites in this region. Livestock producers are handicapped not only by large direct losses but also by such intangible losses as failure of young animals to grow normally and decreases in production of meat, milk, wool, and eggs. The producer also suffers from other angles for diseased and parasitized animals are inefficient workers and make uneconomical use of their feed. Under normal conditions farm livestock should be economical producers in order to pay their way. The present need for animal products makes it imperative that every effort should be used to obtain maximum production economically.

The laboratory was planned to aid in solving the problems of major significance in the region. Johne's disease and gastro-intestinal parasites of cattle were selected for initial study. The results obtained in these investigations will serve as a basis for determining the nature and control of other diseases and parasites of domestic animals.

The laboratory has worked out a reasonably certain procedure for producing coccidiosis in experimental animals by artificial inoculation. The difficulty experienced by other workers in producing clinical cases appeared to be due to failure to feed sufficiently large numbers of coccidia. In the laboratory procedure the number given was often as high as fifty million. The perfection of this technique enables the laboratory to have available affected animals for experiments. The life cycles of some of the species of coccidia (there are at least nine which attack cattle) have been studied and the symptoms produced by them have been recorded. This information has been used in analyzing the number and kind of coccidia affecting dairy calves under farm conditions. In this work it was found that the age of the host varied inversely with the total coccidial discharge. Certain coccidial species were more frequently encountered and were more abundant than others. A sequence in the time of appearance of the several species was discovered. It was ascertained that a large percentage of the undiagnosed diseases of the digestive tract of dairy calves between the ages of weeks and 6 months are caused by coccidia. The information thus obtained helps to bridge the gaps in the knowledge between outright clinical coccidiosis and the carrier state and provides the basis to a logical approach to problems of transmission and control.

Studies on the control of coccidiosis under field conditions by means of sanitation and segregation of animals by ages are being continued. The program has been followed with success on several dairy farms in the region. Preliminary work showed that sulfaguanidine had some value as a preventive treatment. However, the experiments with this drug have not progressed far enough to make recommendations for its use on dairy farms.

Internal parasites are perhaps the most insidious of the animal disorders in the region since there may be no outward manifestations of their presence until debility has become pronounced. Post-mortem examination of parasitized cattle has shown which parasites occur most frequently and in the largest numbers. Stomach worms, nodular worms, and hookworms were the most prevalent and caused great damage. In a cooperative study with the Florida Experiment Station it was found that hookworms and lungworms failed to live through the winter on unused pasture, while stomach worms, nodular worms, and several other species survived and infected cattle placed on such pastures 140 days after the parasitized cattle were removed. Experiments at the laboratory showed that lungworms are readily transmitted from one animal to another when grazing together even on well-drained and comparatively dry pasture. Resting a pasture about 6 weeks during spring or fall is apparently sufficient to rid the pasture of infective lungworm larvae in the locality of the laboratory. Stomach worms and nodular worms were most successful in surviving through the winter.

An investigation was conducted by the laboratory to determine the resistance of calves to natural reinfection with stomach worms. Yearlings that had been previously infected experimentally with stomach worms but had eliminated the

parasites were placed on an infected pasture with animals that had received no previous treatment. Stomach worms failed to develop in the animals that had been infected, whereas the control animals acquired large numbers of these parasites.

The effect of diet upon the degree of infection with stomach worms was investigated by the laboratory. Calves which from birth to the termination of the experiment received only milk harbored significantly smaller numbers of the worms than did their controls fed a diet of cow's milk, alfalfa hay and grain. In other experiments calves weaned from milk at three months of age harbored approximately five times as many worms when experimentally infected as did calves that continued to receive milk in addition to hay and grain. Decreased acidity of the gastric contents was observed during milk feeding. This change may have been responsible for the failure of the parasites to develop. The results indicate that for the control of stomach worms in calves, recommendations should be made against early weaning.

A high percentage of the herds examined in the region were found to have reactors to the johnin test for Johne's disease. In many of these herds there had been no outward symptoms of the disease, but autopsy of reacting animals revealed organisms indistinguishable from the Johne's disease organism in the intestinal tract. It was ascertained that a considerable percentage of the cattle which have Johne's disease react to the tuberculin test. This finding accounts for at least some of the no-visible lesion reactors that are discovered in testing cattle for tuberculosis.

Since the diagnostic material, johnin, used for identifying infected animals has not been as accurate as is desirable, many experiments have been conducted to improve the product. The laboratory has developed a method of artificially sensitizing the skin of cattle. The procedure makes it possible to test the potency of several johnins in the same cow at the same time, a procedure that should hasten the development of a reliable and accurate diagnostic agent.

Laboratory for the Improvement of Viability in Poultry in the North Central and Northeastern Regions: (Approved by the Secretary, December 23, 1937; located at East Lansing, Michigan). The billion dollar poultry industry of the United States is handicapped by a yearly mortality of one adult hen in every five. In addition, losses of young stock and males of all ages occur. The monetary value of these losses and of the decrease in egg production that can be ascribed directly to disease is estimated to be one-tenth of the total value of the poultry enterprise. The disease condition credited with causing the highest mortality among chickens is known as the avian-leukosis complex, or "fowl paralysis" and allied diseases, the most common manifestations of which are paralysis, blindness, and an involvement of the visceral organs. The laboratory in studying this disease complex, including the development of measures for its prevention and control, has developed a coordinated program of research involving genetics, pathology, physiology, nutrition and management.

Of the 1,130 White Leghorn chickens raised for prospective breeders at the laboratory in 1941, 21 percent died from the avian-leukosis complex before or by the time they reached 300 days of age. An analysis of the records of these birds showed that mortality from this disease complex appeared much more frequently in some families (the progeny of a given sire and a given dam) than in other families. For example, in one family with a total of 20 progeny, there was a mortality of only 2 chickens, and this loss was not caused by the avian-leukosis complex. In another family consisting originally of 18 chickens, there was a total mortality of 15 birds, 14 of which died with manifestations of the avian-leukosis complex.

The only known variable among these chickens was the breeding of the birds. Even though the differences in mortality are significant, the character of resistance is not sufficiently fixed in all the progeny of any one family to permit their use in the propagation of a line of birds with the expectation that they will transmit uniformly the quality of resistance to their offspring. For this reason breeding birds are not only selected for resistance to the avian-leukosis complex as determined by the incidence of the disease among their brothers and sisters under natural conditions, but also as measured by the occurrence of the disease among other brothers and sisters which have been inoculated with material from affected birds. In addition, and when possible, the final selection of breeding birds is based on the viability of the progeny. The latter procedure, however, requires from 2.5 to 3 years in order to obtain the complete mortality picture of a particular family. In order to overcome some elements in time, the laboratory makes a maximum number of matings, but housing facilities limit the number of mature pullets that can be maintained. For this reason it is probable that progress in developing stock resistant to the avian-leukosis complex will be slow.

Two types of the complex, osteopetrosis (a disease condition manifested by an enlargement of the bones) and erythro-granulo-blastosis (a condition manifested by changes in the blood picture), have failed to appear among a significant number of laboratory chickens. This fact suggests that the agents responsible for these disorders are not spread in the same manner as those responsible for the other manifestations of the disease complex such as paralysis, blindness and visceral involvement. However, these two manifestations of the disease have been reproduced consistently by artificial inoculation with established strains of avian-leukosis complex material.

An analysis was made of 700 cases of the avian-leukosis complex. It was determined that 185, or 26.4 percent, of the cases had two or more manifestations of the disease complex. The remaining 515 cases showed only one type of the disease. The latter cases were classified according to type, as follows:

Paralysis	30.48 percent
Big liver, etc.	58.44 "
Blindness	9.51 "
Big bones	1.55 "

Reports come to the laboratory from poultrymen to the effect that the mortality of their chickens remains high but that deaths occur which are not associated

with paralysis and blindness as formerly. On such farms it is likely that much of the mortality is caused by the visceral type of the disease complex. This apparent transition has given rise to the belief among investigators that there is a common causative agent for the different manifestations of the avian-leukosis complex. The laboratory is striving to determine the relationship, if any, between or among the different types of the disease complex.

The laboratory program has developed new facts regarding the various manifestations of the disease complex and has greatly improved diagnostic techniques for determining the presence of the disease. However, until a scientific basis for control of the disease has been worked out, the annual monetary loss of \$100,000,000 will continue a major hazard to poultry production with possibilities of increased losses.

Laboratory for Investigations of the Relationship of the Salinity of Irrigation Waters, and of Soil Conditions, to Plant Growth and Related Factors Involved in a Permanently Successful Irrigated Agriculture in the Western Region: (Approved by the Secretary, December 23, 1937; located at Riverside, California). In order to provide food for military and civilian needs and to meet the food requirements of the Lend-Lease program, effective production must be maintained on all land suitable for cultivation. There are about 20 million acres under irrigation west of the Mississippi River and of this, an estimated 9 million acres have had their productivity impaired or threatened by excessive accumulation of soluble salts. Thousands of acres already have been abandoned because of salinity. The laboratory is developing and improving methods of leaching salts from soils through improved drainage, is selecting salt-tolerant crops or strains of these crops, and is determining what cultural practices will reduce salt accumulations or their effects upon plants.

Leaching and drainage of irrigated lands may be limited by the presence of artesian conditions, by the impermeability of the soil, or by the lack of a good system for collecting the water, such as open ditches, tiles, or a sandy layer permitting lateral flow of some outlet. The soil probe developed by the laboratory last year gave information on the location of impermeable soil layers and the hydraulic head of water at various depths from the soil surface. Additional soil tests have been made by the soil probe and by observation wells in one trial area where it was feared there might be upward pressure such as would occur in an artesian basin. No upward pressure was found, and drainage in this area now appears feasible. Observation wells constructed of small diameter pipe in which the ground water level can be read from day to day give indications of being more useful than the probe. Depth to the water table in these wells is determined by lowering a metal core-insulated tape to the water line where it completes an electrical circuit. Depths to ground water by this means can be read to one-hundredth of a foot. Salinity conditions are usually associated with high water tables, because under these conditions salt accumulates as a residue from evaporation more rapidly than it is removed by drainage. Rising water tables, as determined from observation wells, are a danger signal in any irrigated community. By plotting lines of equal hydraulic head in observation wells on any one day, the direction of water movement within a soil

can be determined and the existence of permeable layers and relatively impermeable layers can be located. With this preliminary information, drains can be installed in the most effective location.

The pressure membrane apparatus developed last year by the laboratory for obtaining soil solutions from soils at lower moisture contents has been found to be a very useful tool. By means of this apparatus, it has been possible to chart the force with which a soil holds moisture whether in a saturated state or in a condition too dry to support plant growth. With this information it is possible to determine the force with which water is held by a soil when the plant begins to wilt. Data obtained in laboratory tests indicated that plants are under greater stress to obtain water under the higher soil moisture levels than had previously been assumed. There were also indications that plants can linger on and obtain some water at lower soil moisture levels than heretofore believed possible. These fundamental studies should lead to a concept of plant wilting when the plant force needed to remove additional water from any soil reaches a certain value. They may also lead to improved instruments to measure water-retaining forces and the amount of water available to plants. These devices would govern irrigation schedules so as to provide ample water for plant use and leaching, yet not waste valuable water.

In greenhouse experiments beans were grown in large containers filled with soil that had received four different salt treatments and were subjected to three irrigation regimes. Yield was reduced by the presence of salt under each method of irrigation. It was further found that the more frequent irrigation regime in which the soil moisture content never approached wilting gave the greatest yields. This is explained mainly on the basis that on the more frequent irrigation schedule the soil solutions always remained relatively diluted while under the less frequent irrigation schedule the soil solutions became at times more concentrated. Under field conditions where salt concentrations are appreciable, these results suggest that plant yields can be increased by more frequent irrigations.

The laboratory has continued its studies on the tolerance of various crops to saline conditions. Garden beets, milo, sugar beets, alfalfa, and cotton have been found to be relatively tolerant, giving 60 to 80 percent of optimum yield at nutrient concentrations of two to three times the normal salt content. On the other hand, peaches, beans, and onions are killed or yield no appreciable amount of fruit at this same concentration. Investigations showed that differences in salt tolerance occurred within strains of a single crop or between hybrids and parent crops. These facts indicate that on saline soils the farmer is more apt to obtain a good crop by growing salt-tolerant plants.

Bean plants grown in nutrient solutions containing an excess of salts absorbed nitrogen and potash at a reduced rate. Analyses of the various forms of nitrogen within the bean plant under these conditions showed that there was a lag in the conversion of nitrogen already absorbed into the more complex nitrogen plant compounds.

Laboratory for Research Into the Relation of Soils to Plant, Animal, and Human Nutrition: (Approved by the Secretary, January 31, 1939: located at Ithaca, New York). In recent years interest has been aroused as to the effects on man and animals when plant or animal products from certain soil areas were used as food. In some cases physiological disorders common among man and animals in certain sections do not occur in other sections of the country. Some soils contain undesirable elements which inhibit the growth of plants and adversely the growth of animals. Knowledge of the number of mineral elements of biological significance has increased in recent years. At the same time, additional and important functions have been ascribed to some that long have been known to be essential. The role in nutrition of many of the so-called minor elements is not fully understood, and it is possible that there are other elements which have biological significance as yet unrecognized.

The laboratory is attempting to determine the effect of mineral elements in the soil on the plants grown on them and the effect in turn on the animals and humans consuming the plants. While the function of the mineral elements in the normal nutrition of plants and animals is important, the effect of deficiencies of one or more of these elements is of equal or greater importance. Continued cropping has depleted soils in some areas of certain of the mineral elements. When these facts are known, it will be possible to replenish these elements through direct application of fertilizers containing them and through agricultural practices.

Two seasons' work with several thousand tomato plants grown in sand cultures has indicated that neither the vitamin C nor the provitamin A content of the fruit is markedly affected by wide variations in the supply of such nutrient elements as calcium, potassium, magnesium, phosphorus, nitrogen, and sulfur. The ascorbic acid (vitamin C) content of the fruits varied considerably with the season. Fruits produced during the winter on hothouse plants had values approximately one-half those of summer-grown fruit. Plants grown in sand cultures supplied with balanced nutrient solutions produced fruit as high or higher in ascorbic acid than those obtained through the use of a good soil. There are also indications that relative length of day is one of the factors influencing ascorbic acid content. Fruit produced during long days had high values than that produced during short days. Varietal differences and differences in climatic environmental conditions under which plants are grown probably have more influence on variations in the vitamin value of tomatoes than variations in soil factors. The quantity of calcium in both fruit and vines could be increased by increasing the amount supplied to the plant. On the other hand, an increase in the potassium supply resulted in a decrease in the calcium, and an increase in the magnesium, content of the fruit. The laboratory also discovered that the amount and percentage of blossom-end rot in the fruit was inversely correlated with the relative amount of calcium in the nutrient solution.

In an effort to evaluate the effect of mineral elements on the nutritive value of other vegetables, the laboratory grew turnip greens in various culture solutions and in two different soils. Analyses of the leaves indicate that their provitamin A content may be correlated closely with the growth v

of the plants, those plants which grew most luxuriantly being richest in provitamin A. Cooperative studies with several experiment stations in the south-east and with the National Institute of Health have revealed significant differences in the cobalt content of turnip greens and other foods grown on different soils. These data show that spinach will accumulate more cobalt than turnip greens and that the leafy foods are generally higher in cobalt than are roots and seeds.

Last year it was reported that the nitrogen content of both the kernel and stover of tetraploid (having four times the usual number of chromosomes) corn was higher than in the diploid (having twice the usual number of chromosomes) in certain strains. This study was extended to a number of red clovers in which the chromosomes had been doubled as in the corn. In this case no difference in the nitrogen content of the plants could be demonstrated. Apparently the chromosome number can have an influence on the nitrogen content of some plants, and thus on the nutritive value of the plants, but certainly no generalization can be made. In other words, a promising plant produced by changing the number of chromosomes will have to be analyzed to determine whether or not its nutritive value has been improved.

The laboratory has continued to study methods for accurately and more rapidly evaluating the nutritive value of plants than is possible with existing methods. A rapid chemical procedure for the determination of provitamin A in the tomato fruit has been successfully completed. The fungus method for analysis for vitamin B₁, reported last year, was used to determine variations in the vitamin B₁ content of wheat from various sources. The results indicated that the variations depended upon variety and growing conditions. Rapid progress is being made in the development of schemes of spectrographic and chemical analyses to correlate the contents of nutritionally important minerals and vitamins in plants and their products.

Since the work of the laboratory is aimed at the production of crops of the highest possible nutritive value, it is closely related to the real objective of the government's increased food production program which is the production of larger quantities of nutrients to meet army, lend-lease, and civilian needs. As examples of additional assistance to the war effort, laboratory staff members are supervising studies of the nutritive value of foods served workers in certain war industry plants to improve the health and efficiency of the workers and the director of the laboratory is assisting in the formulation of such war programs as the National Nutrition Program.

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AGRICULTURAL RESEARCH ADMINISTRATION

OFFICE OF EXPERIMENT STATIONS

(a) PAYMENTS TO STATES, HAWAII, ALASKA,
AND PUERTO RICO FOR AGRICULTURAL EXPERIMENT STATIONS

Appropriation Act, 1943	\$6,926,208
Budget estimates, 1944	<u>7,001,208</u>
Increase	<u>+75,000</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Hatch Act (March 2, 1887) ..	\$720,000	\$720,000	\$720,000	- -
Adams Act (March 16, 1906) .	720,000	720,000	720,000	- -
Purnell Act (February 24, 1925)	2,880,000	2,880,000	2,880,000	- -
Hawaii Station Act (May 16, 1928)	67,500	67,500	90,000	+\$22,500 (1)
Alaska Station Act (February 23, 1929)	15,000	15,000	15,000	- -
Alaska Station Act (June 20, 1936)	10,000	10,000	22,500	+12,500 (2)
Puerto Rico Station Act (March 4, 1931)	50,000	50,000	90,000	+40,000 (3)
Bankhead-Jones Act, Title I (June 29, 1935)	2,463,708	2,463,708	2,463,708	- -
Total estimate or appropriation	6,926,208	6,926,208	7,001,208	+75,000

INCREASES

(1) An increase of \$22,500 to carry out the provisions of the Act of May 16, 1928, which authorizes an appropriation of \$90,000 for the Hawaii Agricultural Experiment Station for the fiscal year 1944.

Objective: To further provide for investigations by the Hawaii Agricultural Experiment Station in order to help maintain food supplies in this strategic and critical area.

The Problem and its Significance: The strategic importance of Hawaii under present conditions is recognized. The maintenance of a food supply is a basic necessity. Reliance upon imports is uncertain. The local production of food is therefore a matter of front line defense in the Pacific. The

work of the Hawaii Agricultural Experiment Station is essential to this phase of defense. Food production is dependent upon the use of facts gained through research in the past and upon prompt answer to emergency questions encountered in the production program. Conditions of altitude, soil, rainfall, and temperature affecting production vary greatly throughout the Islands. Transportation between islands is uncertain and many local questions of production must be answered if food production is to be reasonably effective.

Confronted with this situation, the work of the Hawaii Station, within the limits of the funds available, has been redirected to assist in the food production problems most urgent at a given time, including:

- (1) Assembling and making immediately available reliable information on foods that can be produced in the Islands and their nutritive values.
- (2) Study and experimental trials of locally available materials not ordinarily used for food to determine their production possibilities, nutritive values, and how to use them.
- (3) Developing animal rations out of local forages, molasses, strip cane, pineapple bran, urea, yeast, pigeon peas, kōa haole (leguminous shrub) sweetpotatoes, and other available plant and byproduct materials. The objective is to produce maximum quantities of protective foods -- milk, eggs, poultry, swine, rabbit meat, and beef, ordinarily dependent in considerable measure on imported feeds.
- (4) Experiments with special crops for food, their adaptation, improvement, management, and processing. These include, for example, papaya, litchi, mango, macadamia nuts, soybeans, sweet corn, etc.
- (5) Accelerated tests in the practical control of insect pests and disease especially of truck crops, poultry, and dairy animals under present conditions of limited or restricted supplies of materials and equipment for this purpose and the urgency of methods which can be applied by the small farmer and gardener.
- (6) Serving as a technical advisory agency along all of the above lines and others to the agencies responsible for the actual production in the field.

As indicated more fully by examples following, the Hawaii Station is using its research findings, experience, manpower, and facilities effectively for increasing local food production. The work load in this effort is far greater than under normal conditions. To be immediately effective, new crops, new methods, new techniques, and advisory direction are necessary under diverse conditions throughout the Islands. There are questions which must be answered by field and laboratory tests which would normally not arise because of new crops on areas where they have not previously been grown, inexperienced growers, limited supplies of materials, such as fertilizers, insecticides, fungicides, and equipment, and frequent insufficiency of experimental facts. Budgets have necessarily been adjusted to meet increased costs of labor and materials, such as feeds, fertilizers, and chemicals. Assistance by the station to the extent needed in the emergency can be met only through additional financial support.

Authorization: The appropriations for the Hawaii Agricultural Experiment Station are authorized by the Act of May 16, 1928, which extends to the Territory of Hawaii the benefits of the Hatch, Adams, and Purnell Acts, under which each of the States receives \$90,000 annually for agricultural research. The Act of 1928 authorizes appropriations beginning with \$15,000 in 1930 and a series of successively increasing appropriations until 1941 and subsequent years when the amount authorized is \$90,000. Beginning with the fiscal year 1938 the full amounts authorized have not been appropriated. The appropriation under the Act of May 16, 1928, for the Hawaii Agricultural Experiment Station in relation to the authorization is shown in the following tabulation:

<u>Fiscal Year</u>	<u>Authorized by Act of May 16, 1928</u>	<u>Budget Estimate</u>	<u>Appropriation Act</u>
1938	\$60,000	\$60,000	\$50,000
1939	70,000	60,000	55,000
1940	80,000	60,000	60,000
1941	90,000	70,000	67,500
1942	90,000	67,500	67,500
1943	90,000	67,500	67,500
1944	90,000	90,000	

Progress and Current Program: On Sunday, December 7, 1941, the Hawaiian Islands were attacked by Japan. On Monday, December 8, the Hawaii Agricultural Experiment Station, which for some time had taken an active part in food and feed production planning, immediately geared its work on food production to an actual war basis. A complete Emergency Food Production Plan developed by a special committee headed by the Director of the Hawaii Station had been finished in December 1941, and was adopted by the Army. When military law was declared, the plan found immediate use as a basis for ordering seed, machinery, and fertilizers and in forming planting schedules and acreages of crops. A three-man Advisory Committee for Food Crop Production, including the Director of the Hawaii Station, was appointed by the Military Governor, to advise on the Food Crop Production Program, to direct the allotment of various crops to various locations, and to supervise generally the food crop production program on plantations and farms. The scientists of the station have individually and collectively rendered technical service and advice at the request of the Food Administrator, Office of the Military Governor.

The research program of the Hawaii Station for many years has been aimed at decreasing the dependence of the Islands on the imports of food. The war emergency brings into sharp focus the application of the research findings of the station to the problems of supplying essential foods under the emergency. Examples of the application of the research findings of the station and of work undertaken to solve problems of the emergency follow:

(1) Under an emergency such as confronted Hawaii immediately after the attack on Pearl Harbor the food question had two aspects -- (a) the availability of actual material to eat, and (b) (quite as important) a diet which will preserve health. This brought prominently into the picture the information on nutritive values of Hawaiian foods on which the station had been

working for some years in a limited way. The station was not only prepared at once to serve the Territory conspicuously in an advisory capacity and in the formulation of complete diets for defense workers and armed forces, but it brought together and published in April 1942 information on Vitamin Values of Home-Grown Fruits and Vegetables. This has proved to be of real practical service.

(2) During preceding years the station had been assembling, testing, and breeding sweetpotatoes for Hawaii conditions because of their high potential value for both food and feed. By the time of Pearl Harbor, Hawaii Station strains of real promise for the Islands were available for increase to provide essential food and feed elements. Through the help of the Office of Experiment Stations, all information on sweetpotato processing and uses for food and feed were promptly assembled at the Hawaii Station for use in the Territory. With the help of the Engineering Committee of the Hawaiian Sugar Planters' Association, the station has improvised a machine for shredding sweetpotatoes to be dried for cattle feed.

(3) Research on the value in poultry rations of local products like algaroba bean meal, pigeon pea, koa haole leaf meal, and grain sorghum has already formed the basis for recommended poultry rations of immediate usefulness under restricted importation of feeding concentrates. The value or harmfulness of certain local grasses and shrubs for rabbit feeding has been determined and the results given out for use of the public. The value of small turkeys and Muscovy ducks has been demonstrated for Hawaii and methods of feeding and management worked out.

(4) Research has been intensified on the development and use of locally available forages with emphasis on substitutes for imported high protein feeds essential in dairy and beef rations and on methods of preserving as ensilage such local products as Napier grass, Guinea grass, and sugarcane strippings, with koa haole, Desmanthus, pigeon pea, urea, yeast slurry, and molasses as supplements. Already extensive use is being made of the findings. Urea as an addition to roughages low in protein value has proved its worth in place of a protein concentrate for cattle.

(5) The work of the station over many years on fruits and vegetables adapted to Hawaiian conditions has been of immense service in the emergency in pointing out the best varieties for truck farming and for the Victory Garden Program in which every plantation worker is encouraged to participate. Improved lines of papaya and other tropical fruits and nuts, beans, and tomatoes, and adapted varieties of carrots, onions, and lettuce have contributed to increased plantings of these crops. Practically the only information on cultural methods for large-scale vegetable plantings in Hawaii was developed by the station.

(6) Of particular importance because of high wage rates and shortage of labor are recent special studies on mechanical methods of harvesting crops previously harvested by hand labor. Already achieved is the successful adaptation of the corn binder for harvesting forage crops such as pigeon pea, koa haole, Napier grass, and Guinea grass. Equipment was also successfully worked out for large-scale planting of peanuts, beans, corn, sorghum, carrots, and onions. Tools for cultivation by tractor have been developed. Small growers are also reducing labor and expense through use

of a simple home-made sled planter, a buck scraper, and a drag recently devised by the station for small areas.

(7) Studies on the control of insects affecting important food crops have been expanded. Mimeographed recommendations for the control of many pests have been sent out. Insect and disease problems under tropical conditions are usually far more difficult than on the mainland. Already the work has been exceedingly helpful in dealing with such pests as tuber moth of late Irish potatoes, the leaf miner, stem borer, and weevil of sweetpotatoes, bean pod borer and rust, tomato fruit worm and wilt, and papaya anthracnose, but there is immediate need for much more work along these lines. Experiments with insecticides other than derris and pyrethrum, now affected by war shortages, show some promise.

(8) Parasites of livestock and poultry are major factors working against dairy, meat, and egg production in the Islands. Experiment station results have already brought marked reduction of losses and given encouragement to producers. A new hexachlorothane and kamala treatment developed by the station for liver fluke in cattle was given out in September 1941. Search for methods to control other livestock and poultry parasites is active.

(9) At the request of the Food Administrator, Office of the Military Governor, the station staff has rendered technical service and advice based upon experiment station results, for example: One professional man on swine feeding, feeds and feed rationing; another on cattle feeding, feeds and feed rationing; another on poultry and rabbit feeding, feeds and feed rationing; another on vegetable crops, acreages, culture; another on vegetable and feed production, culture, and mechanical equipment; another on insect control; the Director on advisory committee on food production; and a professional man on nutritive values of foods and diets.

(10) The July 1942 issue of The Agricultural Outlook for Hawaii indicates that through the cooperative effort for which the station has furnished the technical and advisory service "There is now one-third more acreage planted to truck crops in the Territory than a year ago... It is significant that approximately 73 percent of the total acreage and 85 percent of the estimated production of 25 important truck crops reported by plantations and small farmers are on small farms." The station, however, is undertaking to establish unit pilot plantings of vegetable crops on the plantations in order to gain experience with the local problems, work out ways to meet them, and train plantation personnel and labor for the larger job ahead.

(2) An increase of \$12,500 to carry out the provisions of the Act of June 20, 1936, which authorizes an appropriation of \$22,500 for the fiscal year 1944 for the Alaska Agricultural Experiment Station.

Objective: To further provide for investigations by the Alaska Agricultural Experiment Station in order to help meet wartime demands for increased food production.

The Problem and its Significance: War activities in Alaska have created a strong demand for increased production of local food supplies, especially of dairy products, poultry and eggs, vegetables, potatoes, and animal feeds and

for the conservation and preservation of all available food resources. The expansion of military and naval forces, emergency construction programs, and shortages of cargo space and rail transportation have intensified the need for expanding agricultural output in Alaska both currently and as a long-time program.

With very limited funds and research personnel, the Alaska Station is attempting to serve the agricultural research needs of a large and varied area which produces only a portion of the food consumed by the population. Research conducted in the states by the state agricultural experiment stations and the Federal Department of Agriculture is not directly applicable to Alaskan conditions because of differences in such vital agricultural factors as nature of soils, climate, and length of day. The successful production of increased food supplies in Alaska is dependent, therefore, upon the development through research of necessary information.

There is urgent need by farmers for new information in all of the lines of work in progress by the station, and in addition there is a strong demand for new work along economic lines, including farm management, cost of production, and marketing studies. More information is needed on the nutritive value of locally produced foods and feeds. Poultry raising and vegetable and small fruit production can be given only minor attention under the present limited funds. The improvement of facilities and structures for the storage of food products for home use and local markets should be given attention. There is need for research upon problems of barn construction to permit better curing of hay, of the better adaptation of the trench silo, of land clearing, and of the irregular settling of fields due to uneven thawing of the ice layer. Little is known as to the soils of Alaska, their adaptation to particular crops, their requirements for fertilizers and minor elements, and soil conservation practices to maintain productivity.

Authorization: The Alaska Station Act of June 20, 1936, extends to Alaska the benefits of the Adams and Purnell Acts and authorizes appropriations beginning at \$5,000 in 1937 and increasing each year until 1947 when the authorized appropriation is \$37,500, which is one-half of that provided for each state under the Adams and Purnell Acts. Beginning with the fiscal year 1939, the full amounts authorized have not been appropriated. The following tabulation compares the current appropriation under this Act with the authorization since 1939:

<u>Fiscal Year</u>	<u>Authorized by Act of June 20, 1936</u>	<u>Budget Estimate</u>	<u>Appropriation Act</u>
1939	\$10,000	\$10,000	\$ 8,750
1940	12,500	10,000	8,750
1941	15,000	10,000	10,000
1942	17,500	10,000	10,000
1943	20,000	10,000	10,000
1944	22,500	22,500	

Progress and Current Program: The research program of the Alaska Station is carried on in three localities to meet the varied conditions of the Territory.

Experiments at the Fairbanks station in the feeding of oat-pea ensilage to dairy cows have brought about a considerable increase in the construction and use of silos by commercial dairymen and small farmers in Alaska. Best results were obtained in the feeding trials when the ensilage was supplemented with a small amount of hay and 10 pounds of concentrates. High milk production and good general health of the cows were maintained.

Last year it was reported that the trench silo could be used for preserving oat and pea ensilage for winter feeding if given a protective covering of straw or moss. Further experiments during the year have demonstrated that pulverized peat, of which there is an abundant supply in the Territory, is an even better covering.

Until recently the cost of growing heifer calves to maturity in Alaska has been almost prohibitive because of the expense of feeding whole milk or fresh skim milk. The general practice of commercial dairies has been to kill calves at birth and import replacement cows. Based on results of trials at the Matanuska substation, dairymen are now keeping their heifer calves. The station found that after the first thirty to ninety days calves could be raised on a dry ration of locally grown grains plus 20 percent powdered skim milk. Feeding costs in 1941 to five months of age were: \$31.30 for calves fed powdered skim milk in liquid form for ninety days followed by the dry ration, and \$74.05 when given fresh skim milk for the 5-months' period.

Experiments in progress at Fairbanks are pointing the way to successful hog production on small farms in the Tanana Valley. Comparative feeding tests show that hogs can be finished before cold weather sets in when grazed on oat-pea pasture, supplemented by full feeding of home-grown grains. When the tests were begun four years ago, the station had the only hogs in the Valley. Local farmers are now keeping brood sows.

Grasses and legumes for pastures capable of withstanding Alaska winters are one of the major agricultural needs of the Territory. Continuing work is needed to find and adapt high quality forage plants to meet varying conditions over a period of years. During the past few years a considerable number of varieties and strains developed elsewhere have been tested at Fairbanks and Matanuska and some selections have been made. Although many desirable plants were killed during the unusually severe winter of 1941-42, a few came through in good condition. Included among the best survivors of the grasses in the station plots were Kentucky bluegrass, Canada bluegrass, crested wheat grass, creeping red fescue, meadow fescue, brome grass, Reed canary grass, and timothy. The best legumes were alsike clover, Siberian red clover, and perennial vetch.

Fur farming research at Petersburg, formerly supported in part from Federal-grant funds, is now being carried chiefly on Territorial funds and funds made available by the Alaska Fish and Game Commission.

(3) An increase of \$40,000 to carry out the provisions of the Act of March 4, 1931, which authorizes an appropriation of \$90,000 for the Puerto Rico Agricultural Experiment Station for the fiscal year 1944.

Objective: To further provide for research by the agricultural experiment station at the University of Puerto Rico to help meet the serious food shortage existing in Puerto Rico under present war conditions.

The Problem and its Significance: The strategic importance of Puerto Rico under existing conditions is recognized. Puerto Rico has a population of about 550,000 people per square mile, which is greater than that of such generally recognized densely populated countries as Japan, Italy, and Germany. The problem of meeting a vastly augmented demand for locally-grown foodstuffs is a basic emergency and public necessity in Puerto Rico. The population, heavy relative to resources even in normal times, has been materially augmented during the past year or more by both armed forces and civilian war workers from the Continent. Difficulties of transportation, greatly accentuated by present conditions, make the supply of imported foodstuffs inadequate and uncertain.

The local production of foodstuffs, therefore, on the limited acreages available is an essential phase of defense. The work of the agricultural experiment station of the University of Puerto Rico at Rio Piedras is essential to this phase of defense. The production of plant and animal products under greatly increased production goals is taxing the resources of the Island and the resourcefulness of the station staff to the very limit. Food production is dependent not only upon facts gained through previous research but also emergency studies promptly made as particular questions arise. Because of great variations in altitude, soil, rainfall, temperature, and crop adaptations, the problems of production vary greatly from area to area over the Island. The enormous quantities of foodstuffs ordinarily imported must be replaced to the maximum practicable extent by the production of locally-produced foodstuffs. Not only is ocean-going transportation inadequate but restricted transportation on the Island gives rise to problems connected with the movement of farm products and their processing and storage.

Some examples of increases in the 1942 production goals over 1940 follow:

<u>Commodity</u>	<u>Increase in quantity</u>	<u>Increase in percent</u>
Rice	1,000,000 pounds	17%
Corn	5,000,000 pounds	100%
Green bananas	24,000,000 pounds	10%
Plantains	45,000,000 pounds	36%
Sweetpotatoes	22,000,000 pounds	32%
Yautias	20,000,000 pounds	50%
Fresh vegetables	22,000,000 pounds	38%
Ripe bananas	25,000,000 pounds	41%
Beans	17,000,000 pounds	100%
Pigeon peas	10,000,000 pounds	66%
Other peas	2,000,000 pounds	40%
Pork	2,000,000 pounds	22%
Poultry	4,000,000 pounds	40%
Other meats (goats, etc.)	1,000,000 pounds	100%
Fish	1,000,000 pounds	25%
Eggs	2,000,000 dozen	26%

Confronted with this situation, the research program of the agricultural experiment station of the University of Puerto Rico at Rio Piedras has been redirected to assist in the food production problems most urgent at a given time, including:

- (1) Assembling and making available immediately reliable information on foods that can be produced in the Islands and their nutritive values.
- (2) Study and experimental trials of locally available materials not ordinarily used for food to determine their production possibilities, nutritive values, and how to use them.
- (3) In the absence of concentrates from the Continent to feed the dairy cattle, poultry, and swine of the Island, developing rations out of locally-grown grasses and legumes, molasses, sweetpotatoes, and other available feeding stuffs. The purpose is to supply adequate quantities of food not only for the nourishment of the people but also to protect their health during the war. Items to be greatly expanded in production include milk, poultry, eggs, swine, and goats. These have heretofore been fed in large part from concentrates imported from the States and to some extent on locally-grown feeding stuff, principally forages.
- (4) Quick tests over the Island of recently introduced crops, such as soybeans for food, their adaptation, improvement, production, processing, and storage.
- (5) Quick tests in the control of insect pests and diseases of food crops, poultry, dairy animals, under conditions of inadequate supplies of materials and equipment for these purposes, and the extreme need for methods of control which can be applied by farmers.
- (6) Serving in a technical advisory capacity to the Government of Puerto Rico, including the Insular Department of Agriculture, the Extension Service, and other Insular and Federal agencies serving the agricultural and rural life of the Island.
- (7) Serving as a source of seeds and plants of varieties and strains of food crops found adapted to the Island, including casava, yautia, beans, and corn.
- (8) Supplying camouflage and other necessary plants to the armed forces; supplying direct production of food crops for local consumption, or surplus acreage.
- (9) The station is serving the war purpose in other ways. It provides high-yielding disease-resistant varieties of sugarcane for the sugar growers. Cotton breeders of the station have developed a strain of Sea Island cotton for the staple of 2 inches or longer needed for making lighter-than-air crafts and for other war purposes. The Commodity Credit Corporation made a contract with independent growers and with a cooperative for the growing of large quantities of this extra long fiber cotton at a price remunerative to the growers. This station furnished the original seed for these growers and agreed with the Commodity Credit Corporation to grow annually under careful supervision about 30 acres of seed which will be distributed to the growers each season. This plan will continue during the war period.

(10) Miscellaneous services to the armed forces, too numerous to mention, include, for example: Spraying material for airplane fumigation, control of diseases and insect pests on landing fields, termite control, local manufacture of vinegar from citrus and other fruit juices, local manufacture of soap, membership in defense boards, and services by the Director as a special member of the Insular War Board. To help provide food in the Rio Piedras area the station is growing 110 acres of food crops in that vicinity.

The efforts of the station to furnish vitally needed seed stock for the production of plant and animal foodstuffs on the Island should be expanded to a scale sufficiently extensive to meet the emergency and public necessity for both the civil and military population of the Island and the technical participation by the station in supporting the many other nontechnical agencies should be continued.

Authorization: The Puerto Rico Station Act of March 4, 1931, which authorizes the increase of \$40,000 extends to Puerto Rico the benefits of the Hatch, Adams, and Purnell Acts, and authorizes successively increasing appropriations each year until 1944 when the amount reaches \$90,000, the same as each state receives under the Hatch, Adams, and Purnell Acts. Beginning with the fiscal year 1939, the full amounts authorized have not been appropriated. The appropriation for the Puerto Rico Agricultural Experiment Station is now four years in arrears of the authorization, as shown in the following tabulation of action taken in regard to this item:

Fiscal Year	Authorized by Act of March 4, 1931	Budget Estimate	Appropriation Act
1939	\$45,000	\$45,000	\$42,500
1940	50,000	45,000	45,000
1941	60,000	50,000	50,000
1942	70,000	50,000	50,000
1943	80,000	50,000	50,000
1944	90,000	90,000	

Progress and Current Program: The necessity for growing more plant and animal products as food for local consumption has long been recognized and has been strongly emphasized over the past two years. Following December 7, 1941, however, all the resources of the station and of the Island and all the resourcefulness of the people of Puerto Rico and the officials of its Government were put to work to meet this problem, already acute, and now by war made an emergency and public necessity. The station, therefore, is not only conducting research designed to relieve the food emergency but to help put the findings of the station actually to work on the farms of the Island. To do this, it participates in all the many activities of the Island dealing with war purposes.

Some examples of how the station is helping meet the emergency follow:

(1) With the Island annually consuming some 385,000,000 pounds of cereals, including 269,000,000 pounds of rice, and with these cut off for lack of transportation, corn is an available local substitute. The 1942 production

goal for corn is 10,000,000 pounds, or 100 percent increase over 1940. The station has developed some native strains of corn yielding up to more than 68 bushels per acre compared with 36 bushels per acre on a "check area." Some of this corn is now ready for distribution and is being increased as fast as possible.

(2) The Island is terribly short on proteins as a part of the diet for maintenance, growth, and health. Beans provide suitable proteins and B vitamins needed for health. The station during the past five years has developed and is now distributing seed of a native red bean and a native white bean which are suited to the Island conditions. Four strains which have proved most promising have been distributed to Federal and Insular agencies and individual farmers. Over 800 pounds of seed were released to the W. P. A., vocational schools, individual farmers, and victory gardeners for the building up of the seed supply. Last spring more than 25 acres were planted by the station and these in turn will yield seeds enough to plant 350 or more acres. Considering the acute shortage of bean seed on the Island and the practical impossibility of importing and growing seeds from the Mainland, the release of the four high-yielding selections for general use during this emergency is an important service to the Island.

(3) For income and as a source of vitamins A and C for health, as well as for a condiment, the station has developed and is now testing, with a view to distribution among the farmers of the Island, commercial varieties of sweet and pimiento peppers resistant to mosaic.

(4) The tomato is important as a source of farm income and vitamin C for health. The station is working at the development of a mosaic-resistant tomato to overcome this disease, a major problem in tomato production.

(5) Owing to the high average temperature and humidity of the Island, the preservation of planting seed from one season to another is a very difficult problem. The station is conducting experiments on drying planting seeds, carrying them in low temperature storages, and fumigation, with decidedly successful results. This is a direct help to the production goals of the Island.

(6) Conditions on the Island make the processing and storage of large quantities of foodstuffs necessary. To help visualize the nature and size of the problem of canning and processing, the station made a thoroughgoing survey of such establishments throughout the Island. These data enable leaders to estimate the number of establishments needed on the Island for this purpose.

(7) To help keep production moving toward goals and hold costs down, the station determines the cost of production of important agricultural products. This information is helpful in keeping costs down and remunerative prices consistent with consumer purchasing power.

(8) Since the continental markets are practically cut off for lack of shipping, particularly ships with refrigeration, practically all farm products are necessarily marketed locally in Puerto Rico now. To make marketing efficient and effective, the station is conducting a study that keeps it abreast of the best marketing practices to be followed on the Island during the war period as well as after.

(9) With a view to producing the Puerto Rican sugar quota on a smaller acreage and thus release fertile sugar lands for food production during the war, the station is breeding highly productive disease-resistant varieties of sugarcane and distributing them to growers and rendering other protective services such as insect and disease control to the growers.

(10) The Island also faces the possibility of shortage of medicines with which to combat disease and illness. The station is studying the chemical composition and uses of native Puerto Rican botanical drugs and their possible commercial development on the Island. Among plants studied are those that yield saponin, aloes, and chenopodium. It is thought that all the chenopodium needed on the Island for combatting round worms, hookworms, and intestinal amoeba can be produced on the Island.

(11) A number of studies have been made to help make the thousands of acres of coffee planted in the more mountainous areas produce economically, and thus help supply our coffee needs during the war when we are having difficulty getting enough coffee from Central and South America. Included are studies on how to fertilize, shade, prune, and protect coffee from diseases and insect pests.

(12) The fresh milk supply of the Island is inadequate to supply the population with a minimum requirement for health. The station is doing what it can to augment its supply of meat, poultry, eggs, and milk. An emergency study undertaken the past spring was on the value and use of livestock feeds available in Puerto Rico. The concentrates usually imported from the Continent are not always available for lack of shipping facilities. The station is endeavoring to develop rations which may be fed to all types of farm animals and poultry to maintain production and attain goals which are relatively very high. Another study is the study on the production of forage crops, including grasses and legumes, and on concentrated feeding stuffs grown in Puerto Rico. This study is furnishing background data for the preceding one on available feedstuffs.

(13) It is a matter of experience that livestock and poultry do not respond to feed and care in Puerto Rico as in the northern temperate zones. With a view to the development of methods of feeding which will overcome this apparent inertia of animals in the Tropics, the station has just begun studying the effects of climate on animal production. It is hoped that efficient animal production may be accomplished either by proper feeding methods or ultimately by the development of better adapted animals or by both processes.

(14) To speed up increase in poultry and poultry production in Puerto Rico, the station is experimenting on the improvement of the native poultry of the Island by determining the types best suited to improvement and the kinds of cockerels to be used in improving the poultry. Increase of desirable poultry is being distributed to farmers.

(15) Swine are the best source of meat available on the Island. It is not only a protein food but also the best available meat carrying relatively high vitamin B complex needed for health and manpower on the Island. Free boar service is being offered farmers in order to speed up pig production.

CHANGE IN LANGUAGE

appropriation: PAYMENTS TO STATES, HAWAII, ALASKA, AND PUERTO RICO FOR
AGRICULTURAL EXPERIMENT STATIONS, Title I, Bankhead-Jones
Act

The estimates include a proposed change in the language of this item as follows
(deleted matter enclosed in brackets, new language underscored):

Title I, Bankhead-Jones Act: For payments to States, Hawaii, Alaska, and
Puerto Rico, pursuant to authorizations contained in Title I of an Act
entitled "An Act to provide for research into basic laws and principles
relating to agriculture and to provide for the further development of
cooperative agricultural extension work and the more complete endowment
and support of land-grant colleges", approved June 29, 1935
(7 U. S. C. 427-427g), \$2,463,708: Provided, That [of this amount
\$63,708 allotted in the fiscal year 1942] in order to prevent reduced
allotments because of changes in relative rural population, [shall be
apportioned in the fiscal year 1943] \$63,708 of this appropriation
shall be available for allotment during this fiscal year in the same
amounts and to the same States and Territory which received allotments
from [such sum] this appropriation in the fiscal year 1942.

This change of language is proposed in order to make possible the distribution
of this appropriation to the various States, Territories, and Puerto Rico in
the same amounts as were allotted for the fiscal years 1942 and 1943.

WORK UNDER THIS APPROPRIATION

General: The several appropriations under "Payments to States, etc." represent
the Federal Government's support to the State, Territorial, and Puerto Rican
agricultural experiment stations which were established as departments of the
land-grant colleges pursuant to the provisions of the Hatch Act of 1887.

The object and duty of the state agricultural experiment stations is to con-
duct researches and experiments along the lines authorized by the several
Federal-grant fund acts and the complementary acts of the states on the many
problems constantly encountered in the development of a permanent and sustain-
ing agriculture and in the improvement of the economic and social welfare of
the farm family.

The primary function and obligation of the state agricultural experiment sta-
tions is to meet the needs of the farmers of the several states through the
study and solution of state and local problems. This function is expressed
in the Hatch Act of 1887 and the Adams Act of 1906, which specify, in author-
izing appropriations for these stations for agricultural research, that the
investigations conducted should be with "due regard to the varying conditions
and needs of the respective states and Territories."

In addition to their function of serving state and local needs, the research
programs of the state stations, to be most effective, include participation
in regional and national programs. Since the economic and social welfare of

the rural population and the general consumer public of a state is definitely affected by, and definitely related to, the welfare of the population of other states, joint attack by a group of state stations is the most effective and often the only practical approach to problems of common interest.

The research programs of the state agricultural experiment stations and the United States Department of Agriculture are supplementary and interdependent. The Department of Agriculture, having primary responsibility to improve agriculture and the rural home for the whole country, approaches agricultural problems from the regional and national viewpoint, but without losing sight of the fact that the individual farm and farm family is the fundamental unit of American agriculture. A large part of the research work of the state stations and the Department is conducted on an actively cooperative basis to use all available resources to the best advantage. The state agricultural experiment stations, for example, look to the Department of Agriculture for leadership in the solution of regional and national problems, for synthesizing the results of related research, and for assistance in attacking new problems of potential regional or national significance. The Department, on the other hand, depends upon the state agricultural experiment stations for bringing to bear upon problems an intimate knowledge of local conditions and adapting the general conclusions or developments of the Department and broadly cooperative research to the varying conditions of the individual states.

Financial Support: The Federal-grant funds for the state agricultural experiment stations are authorized by the Hatch Act of March 2, 1887, the Adams Act of March 16, 1906, the Purnell Act of February 24, 1925, and Title I of the Bankhead-Jones Act of June 29, 1935. As the same stations receive benefits from each of these Acts and the funds are used for the same general purpose, the explanatory notes covering these funds are treated as a unit to avoid repetition of the various statements which apply to each of the funds. The Acts extending the benefits of the Hatch, Adams, and Purnell Acts to Hawaii, Alaska, and Puerto Rico have been discussed under the heading "Increase".

The several appropriations under "Payments to States, etc." provide annually for each state agricultural experiment station \$15,000 under the Hatch Act of March 2, 1887; \$15,000 under the Adams Act of March 16, 1906; \$60,000 under the Purnell Act of February 24, 1925; and for the fiscal year 1943, \$2,463,708 under the Bankhead-Jones Act of June 29, 1935, to the States, Territories, and Puerto Rico, apportioned primarily on the basis of rural population.

For payments to the states, Hawaii, Alaska, and Puerto Rico for agricultural experiment stations, Title I of the Bankhead-Jones Act of June 29, 1935, authorizes the following appropriations to be apportioned on the basis of rural population: Fiscal year 1936, \$600,000; fiscal year 1937, \$1,200,000; fiscal year 1938, \$1,800,000; fiscal year 1939, \$2,400,000; fiscal year 1940 and thereafter, \$3,000,000. Beginning with the fiscal year 1939, the full amounts have not been appropriated. The allotments under this Act, as appropriated to each state, Hawaii, Alaska, and Puerto Rico, in the fiscal years 1942 and 1943, and as estimated for 1944, are shown on Table I, which follows.

TABLE I

ALLOTMENTS TO STATIONS UNDER BANKHEAD-JONES ACT OF JUNE 29, 1935, TITLE I
AS APPROPRIATED 1942 AND 1943, AND BUDGET ESTIMATE 1944

Station	Appropriated 1942 and 1943	
	and Estimated 1944	
	(Basis 1940 rural population	
	and provisos in Approp. Acts)	
Alabama.....	\$82,695.12	
Alaska.....	2,252.44	
Arizona.....	13,285.16	
Arkansas.....	63,983.20	
California.....	81,893.64	
Colorado.....	22,430.96	
Connecticut.....	22,507.32	
Delaware.....	5,189.96	
Florida.....	34,782.16	
Georgia.....	87,522.92	
Hawaii.....	9,186.40	
Idaho.....	14,219.84	
Illinois.....	86,736.52	
Indiana.....	62,900.44	
Iowa.....	64,854.64	
Kansas.....	50,050.96	
Kentucky.....	81,533.32	
Louisiana.....	56,502.80	
Maine.....	20,692.16	
Maryland.....	30,259.72	
Massachusetts.....	18,674.92	
Michigan.....	73,566.60	
Minnesota.....	57,269.04	
Mississippi.....	72,651.40	
Missouri.....	76,967.80	
Montana.....	15,503.16	
Nebraska.....	38,776.60	
Nevada.....	2,734.64	
New Hampshire.....	8,507.40	
New Jersey.....	31,260.32	
New Mexico.....	14,516.00	
New York.....	94,478.24	
North Carolina.....	106,085.56	
North Dakota.....	24,675.76	
Ohio.....	93,717.64	
Oklahoma.....	68,450.84	
Oregon.....	22,790.32	
Pennsylvania.....	135,322.64	
Puerto Rico.....	53,213.24	
Rhode Island.....	2,449.04	
South Carolina.....	59,464.96	
South Dakota.....	24,432.44	
Tennessee.....	77,136.04	
Texas.....	149,364.76	
Utah.....	10,503.68	
Vermont.....	10,471.60	
Virginia.....	71,144.56	
Washington.....	33,254.64	
West Virginia.....	55,859.16	
Wisconsin.....	60,224.88	
Wyoming.....	6,759.52	
Total.....	2,463,707.08	

The only Federal-grant fund act which requires offsetting on the part of the states is the Bankhead-Jones Act. Although none of the other Federal-grant fund acts include such a requirement, the states as an average have been contributing more than \$2 to the support of their agricultural experiment stations to each \$1 of all Federal-grant funds received for agricultural research.

The amount of the Federal-grant fund allotments and income from state sources of each of the state, territorial, and Puerto Rican agricultural experiment stations for the fiscal year 1942 is shown in the following tabulation:

Income of Stations Fiscal Year 1942

Station	Federal	Non-Federal	Total
Alabama.....	3172,695.12	\$538,510.51	\$711,205.63
Alaska.....	27,252.44	26,938.23	54,190.67
Arizona.....	103,285.16	146,840.86	250,126.02
Arkansas.....	153,983.20	218,713.93	372,697.13
California.....	171,893.64	1,362,720.25	1,534,613.39
Colorado.....	112,430.96	221,686.70	334,117.66
Connecticut State.....	56,253.66	150,017.53	206,271.19
Connecticut, Storrs.....	56,253.66	57,082.42	113,336.08
Delaware.....	95,189.96	78,990.89	174,180.85
Florida.....	124,782.16	716,483.05	841,265.21
Georgia.....	177,522.92	110,427.53	287,950.45
Hawaii.....	76,686.40	110,134.73	186,821.13
Idaho.....	104,219.84	75,721.85	179,941.69
Illinois.....	176,736.52	557,004.22	734,730.74
Indiana.....	152,900.44	757,245.46	910,145.90
Iowa.....	154,854.64	462,172.41	617,027.05
Kansas.....	140,050.96	261,280.18	401,331.14
Kentucky.....	171,533.32	259,091.15	430,624.47
Louisiana.....	146,502.80	226,525.69	373,028.49
Maine.....	110,692.16	142,994.20	253,686.36
Maryland.....	120,259.72	170,881.13	291,140.85
Massachusetts.....	108,674.92	150,961.00	259,635.92
Michigan.....	163,566.60	307,615.27	471,181.87
Minnesota.....	147,269.04	500,809.57	648,078.61
Mississippi.....	162,651.40	293,394.25	456,045.65
Missouri.....	166,967.80	225,580.87	392,548.67
Montana.....	105,503.16	176,891.43	282,394.59
Nebraska.....	128,776.60	216,329.94	345,106.54
Nevada.....	92,734.64	19,316.15	112,050.79
New Hampshire.....	98,507.40	21,478.44	119,985.34
New Jersey.....	121,260.32	332,093.00	453,353.32
New Mexico.....	104,516.00	95,304.40	199,820.40
New York, Cornell.....	166,030.40	851,850.63	1,017,881.03
New York State.....	18,447.84	385,390.28	403,838.12
North Carolina.....	196,085.56	199,930.33	396,015.89
North Dakota.....	114,675.76	104,718.31	219,394.07
Ohio.....	183,717.64	1,254,619.05	1,438,336.69
Oklahoma.....	158,450.84	328,367.11	486,817.95
Oregon.....	112,790.32	352,135.59	464,925.91
Pennsylvania.....	225,322.64	240,800.76	466,123.40
Puerto Rico.....	103,213.24	190,430.65	293,652.89
Rhode Island.....	92,449.04	9,286.52	101,735.56
South Carolina.....	149,464.96	272,243.11	421,708.07
South Dakota.....	114,432.44	98,201.97	212,634.41
Tennessee.....	167,136.04	157,403.20	324,539.24
Texas.....	239,364.76	863,348.81	1,102,713.57
Utah.....	100,503.68	62,236.70	162,740.38
Vermont.....	100,471.60	10,471.60	110,943.20
Virginia.....	161,144.56	127,653.37	288,797.93
Washington.....	123,254.64	257,743.22	381,002.86
West Virginia.....	145,859.16	126,473.45	272,332.61
Wisconsin.....	150,224.88	580,412.00	730,636.88
Wyoming.....	96,759.52	106,237.33	202,996.85
Total	6,926,207.08	15,572,195.23	22,498,402.31

Progress and Current Programs: The payments to the states under the several Federal-grant acts have enabled the state agricultural experiment stations to make large contributions to the solution of agricultural problems in peacetime and to play an important part during the current emergency in the war efforts of the Nation. The state agricultural experiment stations have responsibility for carrying on experiments and conducting research directed to the solution of problems of the individual states and for participating in agricultural research programs directed to the needs and welfare of the Nation as a whole.

Wartime demands have greatly intensified these responsibilities. The war emergency has not only increased the need for speeding up research dealing with problems basic to the maintenance of agriculture as an essential part of the national structure, but has brought forth a host of new problems of urgent immediate character bearing directly upon war requirements in the production of foods and agricultural products for war purposes and for civilian defense needs.

The setting up and attainment of production goals for food and strategic agricultural products require a great deal of background information of detailed local character as to productive capacities of soils and farm animals, labor and machinery requirements, varieties and breeds, fertilizer and feed uses, insect and disease hazards, and methods of harvesting, processing, storage, and marketing. Much general information of this type accumulated by the experiment stations in past research has been assembled, analyzed, and made available for immediate use. Much additional research effort is needed, however, due to the fact that each acre and livestock unit must be pushed to maximum productive capacity, that production must be extended to new areas to meet certain goals, that shortages of agricultural labor require greater use of machinery and unskilled help, and that substitutes must be found for fertilizers, feeds, spray chemicals, and packaging materials formerly available.

New problems of pressing importance for research solution are being imposed by wartime changes in marketing and transportation facilities requiring conservation of trucks, tires, fuel, and men in the movement of farm products and farm supplies.

Restrictions on imports of strategic and critical materials have imposed new demands on research to explore possibilities of replacement with other products of domestic origin or of producing them in the United States. This is true of many oil, fiber, drug, and condiment plants, of rubber-bearing plants and plant sources of synthetic rubber, and of seed stocks of certain vegetables, grasses, and legumes.

Metal shortages and space limitations, especially in overseas shipments, have created an urgent need for research on new types of food containers and the preservation of food products by dehydration, including equipment, methods, conservation of nutritive values, and determination of the varieties best suited to dehydration.

In addition to these aspects of agricultural research problems, which are chiefly those of providing adequate supplies of food and raw materials for military and civilian needs, many unpredictable and unusual problems lying within the scope of the services and functions of the experiment stations are developing that relate directly to military operations.

Farmers of the individual states and state and local agencies, such as war boards, nutrition councils, labor boards, and transportation committees, look to their state agricultural experiment stations for research assistance on state and local problems. Military establishments and defense industries, appreciative of the value of first-hand information applying directly to local conditions, are turning more and more to the state stations for advice and research services where new facts are needed.

The number of demands on the experiment stations have increased progressively. The indications are that there will be further increased demand due to the need for increased total production and larger supplies of specific products, such as fats and oils, meats, rubber, fibers, and other strategic materials. Because of the character and volume of these demands and the wide variety of questions to be met in the individual localities, the state experiment stations should be in a position to render the maximum technical support to the agencies responsible for administrative action.

Research adjustments begun early in the defense period to permit the greatest possible emergency aid were accelerated and directed to war goals and needs after Pearl Harbor. By July 1941, the shift to emergency problems involved 20 per cent of the Federal-fund projects of the experiment stations and at the close of the fiscal year 1942 an additional 23 per cent had been replaced by new projects important to the war effort or revised to meet wartime needs. During 1942, there were added an additional 237 projects chiefly of short-time emergency character to meet immediate needs. Thus, at the beginning of the fiscal year 1943 the research activity at the experiment stations has been fully adjusted to meet war conditions and has reached the alltime high of 3,472 Federal-fund projects.

In contributing to the complicated problems raised by the war production effort, the experiment stations are assisting state and Federal agencies in asserbling and interpreting the facts needed for establishing local, state, and national goals. They are assisting farmers to meet production quotas by making available an increasing volume of timely information in the form of clear, concise, simply written circulars and are speeding up research on phases of production problems that limit the realization of maximum yields, such as, for example, how to increase poultry and egg production with substitute rations, how to make limited supplies of nitrogen produce more food and fiber, and how to relieve and overcome critical shortages of farm labor.

Goals for poultry products call for tremendous increases in production. Rations built over the years involving milk byproducts, now needed for food and industry, are no longer available in many sections. In practically all poultry-producing states the experiment stations have necessarily undertaken the responsibility of promptly developing satisfactory nutritive rations out of feed materials available locally. The problem is not an over-all one--because of transportation there are innumerable local aspects to be met.

Goals for certain specified crops call for the maximum production possible per unit of available land. In areas where nitrogen supplies are important limiting factors every experiment station has vigorously increased activity to supplement available commercial fertilizers with additional production of legumes and improved techniques in the placement of fertilizer, including use of liquid forms, to secure maximum crop response. Again, in this important field, the local aspects to be met are thousandfold.

The North Carolina station made an important contribution toward alleviating farm labor shortages created by the monthly movement of some 10,000 laborers from North Carolina farms into the armed services or defense industries by designing a once-over planter and fertilizer distributor that does the work of 6 men and 6 mules.

Tangible aids toward the solution of transportation problems are being rendered by the stations in studies that are resulting in large reductions in milk route mileage and pointing the way to more economical use of farm trucks and rail facilities in the movement of a variety of agricultural products and livestock. For example, studies by the Vermont station of milk assembly routes covering more than half of the State showed that reorganization among companies would affect mileage reductions of 25 percent and reorganization among companies would bring an additional 25 percent saving.

A marked intensification of research activity is being directed to the better use of food for national health and vigor with aspects that have direct application to needs of the armed forces and lend-lease shipments. Many of the state stations and the Department are cooperating in research under the new national cooperative project on the conservation of nutritive values of foods. Progress is being made in developing dehydrators for home and community use and in assisting with home and commercial aspects of dehydration methods.

Investigations having to do with the production of fiber, oil, and drug plants are being accelerated and expanded in attempts to provide home sources of these critical materials. As an illustration of this increased activity, there was a gain in the number of Federal-fund projects dealing with these drugs from 58 to 86 during the fiscal year 1942.

Native plants as sources of rubber are being investigated by several stations and many of the stations are cooperating in the national gwyule and Russian dandelion studies. The development by the New York Cornell station of a method whereby the presence or absence of rubber in plant tissues can be determined in approximately 3 minutes will facilitate these investigations.

Sugar shortages are being eased by new facts on production problems and new findings that permit wider use of substitutes for sucrose, such as the findings of the Massachusetts station that from 25 to 33 percent of the total sugar in most canned fruits, preserves, and jellies may be made up with dextrose without change in color or texture and that the use of more than 30 percent of dextrose in syrups helps to prevent fermentation and mold. State and Department research on waxy starches in corn and sorghums is contributing to independence from imports of cassava starch.

A considerable amount of research aid is being directed by the stations to problems of locating and servicing military establishments and defense industries. In several instances research problems that relate directly to military operations have been undertaken by the experiment stations at the request of the armed forces.

Quarterly reviews of the war activities of the experiment stations and a summary report of examples of progress for the fiscal year 1942 are available, if desired, for the record or for review by the Committee.

(b) ADMINISTRATION OF GRANTS AND
COORDINATION OF RESEARCH WITH STATES

Appropriation Act, 1943	\$165,905
Proposed transfers in 1944 estimates to	
"Salaries and expenses, Library"	-9,750
Total available, 1943	156,155
Budget estimate, 1944	156,010
Decrease (travel funds returned to surplus)	-145

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Administration of Federal grant funds for State and Territorial agricultural experiment stations; coordination of research work of the State and Territorial stations, and coordination of this research with that of the Department; and administration of Department insular stations	\$153,352	\$156,010	\$156,010	
Covered into Treasury in accordance with Public Law 674	- -	145	- -	-\$1
Unobligated balance	1,350	- -	- -	
Total estimate 1944 and compa- rable amounts 1943 and 1942 .	154,702	156,155	156,010	-1

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Administration of grants [to States] and coordination of research with States: [To] For salaries and expenses, including personal services in the District of Columbia necessary to enable the Secretary [of Agriculture] to enforce the provisions of the Acts approved March 2, 1887, March 16, 1906, February 24, 1925, May 16, 1928, February 23, 1929, March 4, 1931, and June 20, 1936, and Acts amendatory [or supplementary]

thereto (7 U.S.C. 361-386f), relative to their administration and for the administration of an agricultural experiment station in Puerto Rico, [including the employment of persons and means in the city of Washington and elsewhere, \$165,905] \$156,010; and the Secretary [of Agriculture] shall prescribe the form of the annual financial statement required under the above Acts, ascertain whether the expenditures are in accordance with their provisions, [coordinate the research work of the Department of Agriculture and] coordinate the research work [of the Department with that] of the State agricultural colleges and experiment stations in the lines authorized in said Acts with research of the Department in similar lines, and make report thereon to Congress.

The proposed changes clarify the language of this appropriation with respect to the responsibilities and functions of this Office and delete responsibility for the coordination of the research of the Department of Agriculture. This responsibility was assigned to the Office of Administrator, Agricultural Research Administration, pursuant to Executive Order No. 9069 of February 23, 1942. Coordination of the research of the state agricultural experiment stations under Federal-grant funds and coordination of this research with similar work of the Department of Agriculture remain the responsibility of the Office of Experiment Stations as a constituent agency of the Agricultural Research Administration.

WORK UNDER THIS APPROPRIATION

Objective: (a) To represent the Department in the administration of the Acts of Congress making appropriations for the support of state and Territorial agricultural experiment stations in the several states, Hawaii, Alaska, and Puerto Rico (Hatch Act, Adams Act, Purnell Act, and the Hawaii, Alaska, and Puerto Rico Station Acts); and (b) to administer the Federal agricultural experiment station in Puerto Rico.

General Plan: Administration of the Acts granting funds to states and Territories involves supervision of the funds, close advisory relations with the stations as to research for which the funds are expended, annual examination of the work and expenditures of each station, assistance to the state stations in working out programs for cooperative effort to avoid duplication, and assistance to Federal agencies in working out cooperation with the states, and preparation of the annual report to Congress on the work and expenditures of the stations, as required by law.

The Federal funds paid to the states and Territories are largely expended on research projects submitted to the Office of Experiment Stations for advisory suggestions and approval in advance of expenditures. Programs of projects with proposed expenditures under the Federal funds are submitted by each station for review and approval at the beginning of each fiscal year. Changes and adjustments in work to best meet state needs are submitted throughout the year.

To carry out the provisions of the Federal Acts, a representative, or representatives, of the Office visits each of the 50 state stations at least once annually and spends four to twenty-one days reviewing the expenditures and the research under way. In addition, staff members cooperate as specialists with individual stations and regional groups in the development and adjustment of research programs for special fields.

As explained under the heading "Special Research Fund, Department of Agriculture," the Office also has the responsibility for the administration of the payments to states authorized by Title I of the Bankhead-Jones Act of June 29, 1935.

Progress and Current Program: The current program of administering Federal-grant funds involves a major responsibility of arranging for prompt, effective cooperation among the states and of the state stations with the Department of Agriculture and with other agencies as needed to attack most effectively problems arising in the emergency. Likewise, there is responsibility for administration of the Federal experiment station at Mayaguez, Puerto Rico, in order to effectively cooperate with the several agencies involved in the inter-American program, especially in acquiring through production or otherwise a number of strategic materials of agricultural origin.

Early in the calendar year 1941, the Office of Experiment Stations began to advise with the state experiment stations on adjustments in their research programs to concentrate on securing information which would likely be needed in the defense period and in the event of war. By the end of the fiscal year--July 1, 1941--approximately 20 per cent of the state experiment station research projects under Federal-grant funds had been closed and replaced by new work on problems of more immediate significance or revised and redirected to include defense activities. During the fiscal year 1942, an additional 23 per cent of active projects were closed and replaced by studies to meet immediate problems, or revised to concentrate on phases of immediate significance. In addition to the change in existing projects, the adjustments resulted in redistribution of the Federal-grant funds to undertake 237 more studies in 1942 than in 1941, the corresponding totals being 3,472 in 1942 and 3,235 in 1941. Of the 1942 total, 574 were begun during the year, 247 were revised to concentrate on securing information of immediate need, and 37 were restored from the inactive list to find answers to problems that had again assumed pressing importance. In a similar way, the research program of approximately 5,100 projects financed from state funds has been revised to meet, as far as possible, the more urgent problems as the changing situation warrants.

As indicated in the statement under the Federal station in Puerto Rico, the research program has been revised and redirected most effectively

to participate in important problems of securing strategic materials, especially insecticides and quinine, and to assist in the urgent problem of food production in Puerto Rico. Aside from changes in the program, staff members' time has been made available for assistance to other agencies because of their specialized training and experience in tropical agriculture. The adjustment of the program and the working out of ways and means for the Mayaguez station to render practical assistance to other agencies has been given attention on the Washington level, as well as by the station staff throughout the year.

Beginning December 8, 1941, immediate action was necessary to authorize adjustments to emergency conditions in Hawaii. The adjustments made and some of the results are described under the Hawaii station item. The Office then took the initiative with suggestions in the States and Puerto Rico. In order to meet the greatly increased production goals, prompt, effective assistance from the technical staffs on the farm, county, state, and regional levels was considered urgent. In order to know, as far as practicable, how the state experiment stations could adjust most effectively to meet the emergency, the annual review of work and expenditures in the field was begun March 1. By the first week in April, the work, expenditures, and problems of 14 state stations had been reviewed by experienced experiment station administrators in cooperation with the station directors and their staffs. On the basis of the findings and experience, plans were made for field review in the other states and as to suggestions practicable of application in the field. From this beginning to date, activity resulting in the adjusted programs as reported under the separate item, Grants to States, Alaska, Hawaii, and Puerto Rico, has been continuous.

In addition, the emergency work load of the Office has greatly increased in arranging for assistance from the state experiment stations to Federal agencies and in furnishing information and assistance to the state experiment stations to avoid, insofar as possible, travel to Washington or to other states. The following illustrate the character and significance of this work load:

(1) In early May 1942, a request was received from the Office for Agricultural War Relations to secure an appraisal and judgment from each of the land-grant colleges as to farm machinery needs for 1943. Immediately the information desired was explained to each of the 48 state station directors, and he was asked to assume responsibility for an appraisal of the situation and a report based upon the combined judgment of the research, extension, and college workers. The request was forwarded May 7 for a report by May 25. The information was secured.

(2) On June 16 each of the state experiment station directors was asked to assist in determining the functional requirements for farm structures. Preliminary reports had been drafted based on data and practices of the Department of Agriculture. Suggestions and advice were needed from the local experiment stations and extension services so that the many possible modifying factors which occur in the different states could be given full consideration in determining functional requirements for farm structures. Each of the experiment station directors was asked to assume responsibility for a careful review by technical staff members and a report as to modifications suggested to meet conditions of the respective state. The cooperation has been secured.

(3) By request of the Office for Agricultural War Relations, June 22, representatives of the state agricultural experiment stations were invited and urged to attend conferences at designated places to discuss fertilizer problems affecting both manufacturers and consumers.

(4) In 1941 the Committee on Food and Nutrition of the National Research Council recommended that the state experiment stations and the Department of Agriculture undertake to determine whether butter in the usual trade channels can be depended upon to furnish a uniform supply of vitamin A and what amount of vitamin A the average person can rely upon in the average consumption of approximately 18 pounds of butter annually. This difficult survey is under way. The Office of Experiment Stations has been serving as a coordinating agency.

(5) The Committee on Food and Nutrition of the National Research Council recommended also that the state experiment stations, with cooperation from the Department, undertake a national study on the conservation of the nutritive value of foods in processing, marketing, storage, and cookery or home preparation. This study in a very complex and difficult field has been undertaken. The Chief of the Office of Experiment Stations, by request, is acting as coordinator in the planning and organization of this national effort.

(6) By letter of August 17, a representative of the War Department asked for assistance in obtaining certain materials needed promptly in connection with ordnance investigations. The director of the state experiment station nearest the area from which the material was desired was asked to secure and ship the samples.

(7) Upon request from the Rubber Coordinator's Office for first-hand information regarding a 2,500-acre rubber plantation in the Hawaiian Islands, the Director of the Hawaii Agricultural Experiment Station on August 10 was asked to have an examination of the plantation made and submit a report.

(8) On a number of occasions requests, with directions, have been wired or sent by air mail to the Federal station in Puerto Rico for assistance in securing sample material and information on tropical plants under consideration as possibilities for production of strategic materials, especially rubber, and to undertake experimental tests in field and laboratory. In like manner, state experiment stations, and even the experiment station in Alaska, have been asked to undertake test plantings of strategic materials, and in other ways to cooperate in securing information in their respective localities to aid in answering questions on a national level.

(9) In September 1941, the Office of Experiment Stations obtained Preference Rating Order No. P-43, Serial No. 2, assigning a preference rating of A-2 to the state agricultural experiment stations for obtaining supplies and equipment for scientific research, along with a similar preference rating for the Department of Agriculture. The work of the Office in connection with the preference rating obtained for the state experiment stations has involved clearance of purchases to be obtained under the preference rating through the Office of Experiment Stations, responsibility of the Office to keep all stations currently advised of the preference rating orders issued, and of procedures applying to the use of the preference rating order, and responsibility of the Office for obtaining and assembling the monthly reports to the War Production Board on the uses of the preference rating order. In addition to general correspondence with the stations on the use of the preference rating order, limitation orders of the War Production Board during the quarter ended June 30 necessitated furnishing each state station information and instructions pertaining to four different limitation orders.

The handling of Preference Rating Order No. P-43, Serial No. 2, by the Office of Experiment Stations has been helpful to both the state stations and the War Production Board in avoiding the necessity of many communications and trips to Washington by state station representatives.

There are almost daily inquiries of some form to answer on the basis of facts available, facts that may be secured, or assistance that may be arranged for. The inquiries in part come from agencies of the Government, as indicated above, and in part from the state agencies seeking to avoid the necessity of delay, time, and expense of coming to Washington. In total, they represent a considerable work load for administrative staff and for clerical and stenographic staff. In our best judgment, they constitute prompt service which would be difficult to secure as promptly and as effectively through other channels.

In an effort to meet the unusual demands placed upon the staff, the detail work and records in connection with the administration of the grant funds are being reduced to a minimum. If war activities continue through 1944, there will be an increase in number of calls from the state agencies on the one hand, and from Federal agencies on the other for assistance in adjusting the research program to war activities. If war activities should

cease by 1944, there will be need for prompt readjustment in research under the approximately \$7,000,000 grant funds plus \$15,000,000 funds of state origin. During 1942, field examination of work and expenditures in Hawaii and Alaska were not practicable. With the staff and funds available in 1943, it is not contemplated that a field examination will be made. By 1944, field examinations should be undertaken both in Hawaii and Alaska. The longer work day and short vacations, if any, are being taken advantage of in meeting the more urgent responsibilities and requests for assistance.

(c) INSULAR EXPERIMENT STATIONS

Appropriation Act, 1943	\$90,592
Budget estimate, 1944	<u>83,292</u>
Decrease (including decrease of \$300 travel funds returned to surplus)	<u>-7,300</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Federal Experiment Station in Puerto Rico	\$82,538	\$90,292	\$83,292	-\$7,000 (1)
Covered into Treasury in accord- ance with Public Law 674	- -	300	- -	-300
Unobligated balance	944	- -	- -	- -
Total	83,482	90,592	83,292	-7,300

DECREASE

The decrease of \$7,300 in this item for 1944 consists of \$300 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$7,000 by elimination of the amount provided in 1943 for badly needed repairs to buildings of the Puerto Rico Experiment Station. As many of the improvements contemplated as possible will have been made before the fiscal year 1944. Because of the difficulties of performing such work under present conditions, this amount is not included in the estimates for 1944.

WORK UNDER THIS APPROPRIATION

The work of the Puerto Rico Experiment Station, as explained more fully below, is now to a large extent directed to problems encountered because of the war. New problems have been presented to the station by the Army and Navy authorities,

by Government officials responsible for the program for hemispheric solidarity and the program to provide sources of strategic materials, and by the circumstances of the location of the station itself.

The work before the war included the subjects of (a) quinine investigations, (b) insecticide plants, (c) vegetable crops, (d) ontological investigations, (e) essential oils, (f) vanilla, (g) bamboo utilization, and (h) introductions of tropical and subtropical plants of possible value. The work as it has now developed to meet war conditions and the progress made are discussed in the following paragraphs:

Quinine investigations: There is no other drug which can be used so effectively as quinine in treating intermittent fevers such as malaria. Practically all the quinine used by the United States, both by the civilian population and the military forces, has been obtained from the Dutch East Indies. As that source is now closed, quinine is a drug of strategic importance. Because of the urgent need for a source of quinine, the work of the station on Cinchona, the tree from whose bark quinine is extracted, has been concentrated on the increase of planting stock. Eight thousand seedling plants have been raised. Areas in Puerto Rico are being investigated as to their suitability for Cinchona production. Cinchona relatives are being studied as to their alkaloid content and possible medicinal value, as well as for the possibility of providing suitable grafting stock for the higher yielding varieties of Cinchona.

In the districts of Puerto Rico subjected to frequent heavy rains, transplanted Cinchona seedlings were beaten into the soil by the rains and did not survive. It was found that the difficulty could be overcome by placing a mulch of fragmented fern leaves around the seedlings. The mulch has the added advantage of preventing excessive drying of the soils when several days of sunny weather occur. Abnormal types of growth of the more mature trees have been traced to nutrient deficiencies, with the possible involvement of toxicity caused by certain soil minerals. A diseased condition (one type of chlorosis) was traced to iron deficiency. The flower biology of Cinchona has been studied as an aid in the breeding work to obtain improved types.

In cooperation with the Office of Foreign Agricultural Relations and the State Department, the Station has encouraged Cinchona production in this hemisphere, by making available to Ecuador the services of a staff member.

Insecticidal plants: Derris root produced in the Far East and Lonchocarpus root produced in South America are the world's sources of supply for rotenone insecticides, which are toxic to many insect pests but harmless to man and domestic animals. Approximately half of our supply of Derris root was formerly obtained from the Far East. The war has closed this source, making Derris root an important strategic material.

To meet the need for increased sources of rotenone, the work on insecticidal plants is now largely directed to the rapid increase of planting stock to establish plantings in Puerto Rico and Latin American countries. At the end of the year 300,000 cuttings of the high-yielding Sarawak Creeping variety of Derris were growing in nursery beds to be ready for distribution during the next 6 months. Growers have been furnished 87,415 cuttings of Derris. Of this number, 61,000 were distributed in Puerto Rico and 26,415 were sent to

Haiti, El Salvador, and Ecuador. Report has been received that the Derris cuttings furnished Haiti have produced satisfactory growth. Plantings are under way for producing 1,000,000 or more cuttings of the station's best varieties as a source of planting stock to increase the supply of rotenone. An experiment to determine the comparative advantage of different spacings of Derris plants showed that spacings of 1, 2, or 3 feet in rows 3-1/2 feet apart had no effect upon the yield or quality of root. Plants 1 or 2 feet apart, however, were not troubled by weeds that developed when plants were set 3 feet apart. The closer plantings, therefore, in addition to saving space, had the advantage of reducing the cost of weeding. Starting with unrooted cuttings, from 885 to 900 pounds of air-dry root, analyzing from 6.26 to 6.51 percent rotenone and 20.69 to 21.72 percent total extractives, were produced per acre. In addition, from 14,825 to 15,112 cuttings per acre were produced that could be used for replanting.

Vegetable crops: An emergency food production program has been developed in Puerto Rico because of its isolated location and the decrease in shipping facilities. The Station is represented on the Advisory Board for the planting program and has directed its vegetable work to aid in this program.

Soybeans, not previously used for human consumption on the Island, have been tested as a possible food crop. The variety Seminole (introduced from China by the Bureau of Plant Industry) has grown well and produced abundantly, a yield at the rate of 1,217 pounds of dry beans per acre having been obtained, as compared with a general yield of 1,200 pounds per acre in the continental United States. Diseases and insects have not limited production, it is possible to obtain two crops per year, and this variety has been readily accepted locally as a new food. To establish soybeans as a food crop in the Island, 4 acres have been planted at the Station for seed production.

Four acres of yams and 4 of sweet corn (developed by the Station) were grown at the Station to provide planting material of these food crops. The Work Projects Administration has cooperated by furnishing labor for the production of planting material. The Station has furnished over 11,000 plants and cuttings of fruit and vegetable plants and over 1,450 pounds of vegetable seeds in local distribution.

To further the program of hemispheric solidarity, planting materials of food crops, such as soybeans, sweet corn, pigeon peas and sugarcane, have been furnished Costa Rica, Cuba, the Dominican Republic, and Ecuador.

Entomological investigations: The work of the Puerto Rico Station involving the introduction, testing, and improvement of many different plants of promising economic, and possibly strategic, importance requires investigations to control the insect pests of these plants. The introduction and liberation of beneficial insects which prey on insect pests have produced fine results.

In addition to the parasite (Harblotonia pseudococcina), which was reported last year as being successful in controlling pineapple mealy bug, another parasite, (Anagyrus coccidivorus), has proved valuable in controlling this pest.

Last year it was reported that introduced scale predators were becoming established in the Island. One of these predators, (Egias platycophalus), has continued to be effective in controlling bamboo scales. Another predator, (Chilocorus cacti), is demonstrating its value in reducing the white scale of papaya and a number of other scale pests. Citrus scales were attacked by another introduced predatory beetle, (Pentilia castanea). During the year, two predatory beetle introductions (Cladis nitidula and Curinus sp.), have been effective against scales, particularly the bamboo scales. The predatory beetle, (Coclophora inaequalis), has continued to demonstrate its effectiveness against other aphids than the yellow sugarcane aphid for which it was primarily introduced.

Two parasites, (Hyaloma chilensis and Acaulona peruviana), of the cotton stainer were received from Peru and liberated in the cotton growing districts in an effort to control this insect pest of cotton. Large numbers of the fly parasites, (Paratheresia distracta), were reared and released to control the sugarcane borer.

Cooperation with other Latin American countries has continued during the past year, beneficial insect material having been sent to Guadeloupe and Guatemala.

Essential oils: For the research on essential oils conducted in cooperation with the Government of Puerto Rico to investigate possible new agricultural crops, the Puerto Rico Station is furnishing technical direction and office, laboratory, and field facilities. The importance of this work has increased with the war, which has seriously reduced supplies of essential oils.

Experiments conducted during the year to determine the practical possibilities of obtaining a flower absolute from coffee flowers in Puerto Rico disclosed that such flowers would yield approximately 0.5 per cent of absolute. If the coffee flower absolute commands as high a price as other flower absolutes, the product should have commercial possibilities. Samples of the absolute have been sent to various perfume dealers to obtain their opinion as to the possible uses of the oil.

Further work has been conducted on the distillation of lemon grass oil which is widely used to perfume toilet articles. Some essential oil bearing plants produce higher yields when dried previous to distillation. It was found, however, in the case of lemon grass, that the highest yield was obtained by distilling fresh grass.

Distillation of lemon grass cut into 1/4-inch pieces resulted in higher yields than those obtained with finely shredded grass. Tests indicated that the dead portions of lemon grass found in the fields with the growing plants contained a commercially recoverable quantity of oil so that it is undesirable to remove such dead material before distillation of fresh lemon grass.

Studies at the Station indicate that lemon grass oil can be produced in Puerto Rico at a cost of approximately 60 cents per pound, including the cost of distillation. Recent quotations on the New York market show the wholesale value of the oil to be between \$3.85 and \$4.50 per pound.

An investigation is in progress to determine the possibility of using an essential oil from a native plant, (*Lippia micromeria* var. *helleri*), as a substitute for the soap antiseptic, origanum, the supply of which is uncertain.

The station has continued its cooperation with Latin American countries by furnishing technical information relating to the cultivation of plants yielding essential oils and by supplying propagating material of such plants. Such cooperation relating to lemon grass has been furnished Argentina and Honduras. Haiti was supplied with planting material of citronella grass.

Vanilla: The Puerto Rico Station furnishes technical direction for vanilla investigations financed largely by the Government of Puerto Rico to provide a new crop of high value per acre for the Island. Because of the more strategic importance of other crops, the work on vanilla was somewhat curtailed during the year.

It was reported last year that experiments were undertaken in regard to the quantity of shade required for the production of vanilla plants. Investigations have shown that vanilla plants will not do well if given more than one-half sunlight. At the end of 15 months, for example, the percentage of seed pieces rotted under full sunlight was 92.1, for two-thirds sunlight, 44.3 for one-half sunlight, 7.7, for one-third sunlight, 7.1. Compared with plants receiving more than one-half sunlight, plants receiving one-half or less sunlight had a significantly higher percentage of healthy plants, of number of cuttings produced, and of number of roots formed.

The use of native tree-fern fiber mixed with mulch has proved a good medium for the growth of vanilla vines. Placing the mulch on top of gravel to afford better soil aeration also helped to reduce root rot.

Bamboo utilization: The work on bamboo during the year has been concentrated on the use of this plant for defense purposes.

The Station, at the request of the Army, has developed a satisfactory revetment construction using living bamboo. Revetments in various forms are valuable military structures to protect men and equipment. Sand filled burlap bags are most frequently used, but they cannot always be obtained and under tropical conditions the bags often disintegrate within a month. In the bamboo revetment

developed, living stalks are planted close together to form a curved palisade backed with soil on the convex side. The bamboo is planted in such a way that the living bamboo stalk will establish along its length new shoot growth and root systems. In this way, all the combined stalks develop into a living revetment requiring practically no maintenance.

Plant introductions: During the year, the work in connection with plant introductions has centered largely in furnishing plants needed by the armed forces. The National Youth Administration has provided labor. The Station has cooperated in landscaping and camouflaging Army and Navy bases by designing planting plans, by designating and furnishing plants, and by supplying instructions as to planting, care of plants, and the control of insect pests. In this work, the station has provided 117,637 plants and 400 cuttings. Requests for more than 250,000 additional plants have been received from the military forces.

In its plant introductions, the Station obtained a number of seeds of Cassia angustifolia, which produces the senna leaves and pods commonly used as a cathartic and formerly imported in large quantities from Arabia and the warm parts of Asia. This introduction holds promise of being suitable for growth in some of the drier parts of Puerto Rico. A tree producing sapucaianuts, a delicious tropical nut, has been established at the Station and should do well in the heavy rainfall districts of the Island.

Other activities in connection with defense: The Station has cooperated with the Bureau of Plant Industry in investigating the value of different Puerto Rico plants, such as Cryptosetegia and Castilla, for the production of rubber.

Because of the shortage of jute, work was undertaken to find native fibrous materials which might be used as a substitute for bags for sand and farm products. Pandanus, cattail, banana leaf-sheaths, royal-palm and cocoanut-palm leaves, and hibiscus and mahoe bark were subjected to durability and weaving tests. Satisfactory bags were woven from pandanus leaves, from a combination of mahoe bark and cattail, and from a combination of hibiscus bark and cattail. However, thus far processing problems have made the cost of production prohibitive. If no other bags were available, production of bags from these native fibers might be feasible.

SUPPLEMENTAL FUNDS
(Complete bureau statement)

Direct Allotments

Project	: Obligations, : : 1942 : :	; Estimated : : Obligations, : : 1943 : :	Estimated : : Obligations, : : 1944 : :
Regional Research Laboratories: Planning and coordination of the program of the regional research laboratories authorized by Section 202 of the Agricultural Adjustment Act of 1938.....	\$7,807	- -	- -
Emergency Relief Appropriations: Planning and review of W.P.A. projects	3,654	\$700	- -
Special Research Fund:			
Administration of payments to States under Title I, Bankhead-Jones Act of June 29, 1935	24,709	23,000	\$22,941
Administration, including the planning, programming, and coordination of special research projects authorized by Title I, Bankhead-Jones Act of June 29, 1935	4,314	- -	- -
Administration, including the planning, programming, and coordination of special research regional laboratories authorized by Title I, Bankhead-Jones Act of June 29, 1935	736	- -	- -
Total, Special Research Fund	29,759	23,000	22,941
TOTAL, SUPPLEMENTAL FUNDS	41,220	23,700	22,941
(Direct allotments)			

PASSENGER-CARRYING VEHICLES

The Office of Experiment Stations does not contemplate any expenditures during the fiscal year 1944 for the purchase of passenger-carrying vehicles. It is expected that the 3 vehicles now being operated will continue in operation during the fiscal year 1944.

AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY

(a) GENERAL ADMINISTRATIVE EXPENSES

Appropriation Act, 1943	\$172,000
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Library"	-4,160
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-2,000
Total available, 1943	165,840
Budget estimate, 1944	165,575
Decrease (including decrease of \$110 travel funds returned to surplus)	<u>-265</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. General administration and business service	\$166,453	\$165,730	\$165,575	-\$155 (1)
Covered into Treasury in accordance with Public Law 674	- -	110	- -	-110
Unobligated balance	727	- -	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942 ...	167,180	165,840	165,575	-265

DECREASE

The decrease of \$265 in this item for 1944 consists of a decrease of \$110 in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$155 due to the curtailment of publication pursuant to Office of War Information Regulation No. 3.

WORK UNDER THIS APPROPRIATION

The general administrative work of the Bureau is conducted under this appropriation. The Bureau is primarily concerned with the protection and development of the livestock industry and animal food resources of the United States. It conducts scientific investigations of the causes, prevention, and treatment of livestock diseases, some of which are transmissible to man; investigates the

prevalence of livestock diseases and aids in their control or eradication, often directing extensive field activities; carries on investigations and experiments in the breeding, feeding and management of livestock; and administers the Federal Meat Inspection Act, the animal quarantine acts, the 28-Hour Law, the diseased-animal transportation acts, and the Virus-Serum-Toxin Act. For facility and economy of operation, administrative functions common to the entire Bureau, which is composed of 10 operating divisions, are grouped directly in the office of the Chief. These include primarily the determination of general policies and the supervision of all activities such as publications, preparation of press releases, motion pictures, and radio programs on the results of Bureau work; budgetary administration including the preparation of estimates; the selection of employees, and other phases of personnel management; the procurement of supplies and equipment and maintenance of property records; the various phases of fiscal management involved in the expenditure of funds; and the receipt, classification and distribution of incoming mail and dispatch of outgoing mail.

(b) ANIMAL HUSBANDRY

Appropriation Act, 1943	\$811,000
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Library"	-3,030
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-6,000
Total available, 1943	\$801,970
Budget estimate, 1944	800,000
Decrease (including decrease of \$1,798 travel funds returned to surplus)	-1,970

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Swine husbandry investigations	\$124,363	\$130,210	\$130,085	-\$125 (1)
2. Sheep and goat husbandry investigations	145,707	140,985	140,985	- -
3. Horse and mule husbandry investigations	41,139	39,054	39,054	- -
4. Beef cattle husbandry investigations	192,597	180,954	180,954	- -
5. Dual-purpose cattle husbandry investigations	68,384	61,796	61,796	- -
6. Poultry husbandry investigations	244,771	240,982	240,935	-47 (1)
7. Certification of pedigrees of imported livestock	6,057	6,191	6,191	- -
Covered into Treasury in accordance with Public Law 374	- -	1,798	- -	-1,798
Unobligated balance	1,560	- -	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	824,578	801,970	800,000	-1,970

DECREASE

The decrease of \$1,970 in this item for 1944 consists of \$1,798 in travel funds (returned to surplus in 1943) and:

(1) A reduction of \$172 due to the discontinuance of publications pursuant to Office of War Information Regulation No. 3.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

Animal husbandry: For investigations and experiments in animal husbandry; for experiments in animal feeding and breeding, including cooperation with the State agricultural experiment stations and other agencies, including repairs and additions to and erection of buildings [absolutely] necessary to carry on the experiments, [\$811,000] \$800,000, including [\$12,500] \$12,410 for livestock experiments and demonstrations at Big Spring or elsewhere in Texas, to be available only when the State of Texas, or other cooperating agency in Texas, shall have appropriated an equal amount or, in the opinion of the Secretary [of Agriculture], shall have furnished its equivalent in value in cooperation for the same purpose during the fiscal year for which appropriations are herein made: Provided, That of the sum thus appropriated [\$242,580] \$240,935 may be used for experiments in poultry feeding and breeding, of which amount [\$45,000] \$44,080 may be used in cooperation with State authorities in the administration of regulations for the improvement of poultry, poultry products, and hatcheries.

The change eliminates the word "absolutely" and is in the interest of simplicity.

WORK UNDER THIS APPROPRIATION

Objective: Through research, to develop means of improving the productivity, both in quantity and quality, of our domestic farm animals and poultry. In addition to research, the work in connection with the administration of the provisions of paragraph 1306 of the Tariff Act of 1930 in regard to the certification of purebred animals imported by citizens of the United States for breeding purposes is carried on under this appropriation.

The Problem and its Significance: Livestock and poultry products vary greatly in quantity and quality per animal unit. Many losses occur which could be avoided by improved breeding, feeding, and management practices. Although the average productivity of the Nation's herds and flocks has increased many fold in the past half century, strains of animals and methods of feeding which

outdo the present average in some cases by one and two hundred percent have been developed. The development of these strains of livestock and of these new principles of feeding repays many times over the research appropriations expended, but such research cannot be done by individual farmers and poultrymen as it is too time-consuming, too costly, and requires far too much pooling of trained talent.

General plan: (1) To test the merits of different systems of breeding; (2) to develop strains possessing inherent characters for high level of performance; (3) to study the various management factors that tend to keep livestock healthy and reduce losses; (4) to determine the fundamental nutritive requirements of livestock; (5) to determine the best methods of using feeds to obtain maximum results in growth and reproduction; and (6) to study the effects of the foregoing and of processing upon the quality of meat, eggs, animal fibers and other productiveness of livestock.

Receipts: During the fiscal year 1942, approximately \$86,000 from the sale of livestock and livestock products which had served their purpose for investigational work was returned to the miscellaneous receipts fund of the Treasury.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited by classes of livestock to show the progress being made on important aspects of the broader problems being studied. During the past year work has been adjusted to meet problems presented by war conditions. Many shifts in emphasis have been made to meet the growing demand for research service to deal with new situations arising out of a greatly expanded livestock production program and the need for new methods of handling and processing livestock products.

Swine investigations: The large increase in production of soybean and other vegetable-source protein meals and the decrease in available animal protein supplements have called for modifications in hog feeding practices. At the same time the situation permits the economical use of more protein in the diet, thereby increasing the rate of growth and the efficiency of gain. These facts have been demonstrated by results of recent experiments on the supplementary feeding of additional protein to suckling pigs, on the increased use of protein feeds throughout the growing period and on the value of different combinations of protein supplements for hogs during the growing and fattening period. This opens the way for speeding up the marketing of hogs thus reducing the peak load on transportation and meat processing facilities.

Results of two winters' work showed that it is profitable to feed ground soybean hay up to 20 percent of the ration provided costs of the hay are not excessive. As with alfalfa leaf meal, the 5 percent and 10 percent levels permitted the most rapid gains and least total feed requirement per 100 pounds of gain. In view of the expected heavy demands for alfalfa leaf meal for poultry and other livestock, this result is particularly valuable at this time.

In view of changed conditions of feed supply and the need for fats as well as pork, a test was conducted to determine the relation between feed intake and output in the form of live weight gain in hogs fed to weights heavier than usual for normal requirements. The results demonstrate that as hogs gain in weight above a certain point, the rate of gain decreases and the amount of feed per unit of gain increases. The data are of basic importance in estimating feed supplies required to finish large numbers of swine at various weights.

Recent results show that the ration may influence the vitamin B₁ content of pork. Since this vitamin is none too plentiful in the average human diet, studies are being continued to determine the value of different swine feeds relative to the vitamin B₁ content of the pork produced. Extensive shifts in supplies of protein feeds requiring the use of feedstuffs not formerly used, make this study particularly important at this time.

In pork studies emphasis has been placed largely on new problems, closely related to the war emergency. These studies have to do with methods of preservation, including dehydration, freezing and freezer storage, and curing. Investigations have been conducted to develop practical methods for producing dehydrated pork that is safe as food and of good keeping quality without refrigeration. This project is a war emergency investigation and stands in front rank of importance.

Coating frozen pork by dipping in melted lard was found to be a promising method for protecting the meat in the freezer, either at 18° F. or 0° F. The rapid expansion of freezer locker storage for farm and home meat supplies, together with the increasing difficulty of obtaining suitable wrapping material for this purpose, opens a wide field of application for these results.

Sheep, goat and animal fiber investigations: The research program under this project has reached a stage where practical application of the results is being made in the Range States. Rams and ewes of the Columbia and Targhee breeds (the two new breeds which the Bureau has produced) are eagerly sought by western sheep men. During the past year rams of these two breeds have been placed with the Arizona, Utah, Colorado, and Montana Experiment Stations for testing on range ewes under an agreement whereby the best individuals are identified through a breeding test and retained for use in further improvement work. At the last annual sale of surplus breeding stock from this project at Dubois, Idaho, 51 breeders paid a total of \$11,000 for 517 head of rams, ram lambs and ewes.

Both the Columbia and the Targhee are hardy, white faced sheep, polled and free from wool blindness and body wrinkles. The Columbia is a large sheep shearing three-eighths Blood and Quarter Blood which indicates wool of medium fineness. A flock of Columbia ewes from this project introduced into Florida have sheared 14 pounds of wool annually per ewe as compared with an average of 5 pounds for native ewes handled under the same conditions. The Targhee is an intermediate size sheep, shearing Half Blood wool. It has been developed to meet the need for a profitable ewe under prevailing western range conditions which favor a sheep carrying 3/4 fine wool and 1/4 long

wool inheritance. Heretofore such sheep had to be produced by continuous crossbreeding, a relatively expensive production method yielding variable results. The enthusiastic reception being given the Targhee sheep by western wool growers indicates that this breed is a definite improvement.

Problems in the management of sheep and ranges in the sagebrush-grass spring-fall areas have been studied in cooperation with the Forest Service. Sagebrush removal by controlled burning has permitted doubling the grazing capacity in three years' time. Phosphorus deficiency in the forage has been found to be reflected in the condition of the sheep grazed on areas in the inter-mountain region.

Recent studies of the relation between body weight and lamb production show that ewes which are heavier in the fall as yearlings averaged more pounds of lamb during their lifetime. The advantage was due to a higher percentage of lambs weaned. Culling flocks on the basis of yearling weight offers an immediate possibility of increasing the production of both lamb meat and wool.

The staff and laboratory facilities on wool and other animal fibers are being used in several emergency projects. The head of the laboratory staff is acting as consultant for the War Production Board, the Army and Navy Munitions Board, and the Federal Specifications Executive Committee in framing specifications which will achieve maximum use of substitute fibers for those in which a serious shortage of supply exists. Work is being done to find fabric use for waste chicken feathers. A series of experiments was conducted to aid the Federal Trade Commission to devise standard methods for determining the amounts of virgin and re-worked wool in manufactured fabrics. The Federal Prison Industries, Inc., has been assisted in a plan to reconver into fabric worn-out garments from Federal prisons. A recent project has considered the deteriorating effects of various agents such as chemicals, enzymes, bacteria, light, and weather upon wool fibers, looking to practical methods for prolonging the usefulness of military fabrics.

Horse and mule investigations: Investigations with horses and mules are concerned primarily with developing measures of energetic efficiency, physiological measures of the effects of variations in nutrition on working performances, and the investigation of reproductive phenomena. Agriculture, commerce, and national defense are highly dependent on an adequate supply of good horses and mules. The need for such stock at this time is particularly significant in agriculture, which has a huge investment in horses and utilizes them as one of the major sources of field motive power. The investigations are designed to help solve many problems which will assist workstock owners in prolonging and improving the period of usefulness of animals now in service and make possible the future production and utilization of superior stock in increasing numbers.

Present day warfare has emphasized the handicap which the transportation of the accepted bulky horse ration constitutes in the use of cavalry and artillery horses. During the year, at the request of the United States Army, preliminary studies were conducted on the suitability and practicability

of using a complete feed (concentrate and roughage combined) as the field ration for military horse and mule stock. The tests indicated that the complete feed was somewhat more efficient on the basis of bulk and weight than the standard army field ration of oats and hay for maintenance of idle horses and those at light and moderate work. Some horses on the complete ration refused to eat enough of the feed to maintain their body weight when at heavy work. Results however were promising enough to justify further test on a large number of cavalry horses under field conditions. In this work, results of the study of minimum roughage requirements of horses obtained thus far indicate that the needs for hay and other bulky feeds may be considerably less than is commonly believed.

Beef and dual-purpose cattle investigations: The war has made necessary an increase in beef cattle production in the United States. In general, there are two methods by which this increase in production may occur, by increasing the production per animal unit and by raising more beef in areas of low production. The Bureau's beef cattle experiments are designed to provide workable information on both of these methods. Studies on environmental influences and the development of crossbred types adapted to the Gulf Coast area show that large areas can be utilized that are not now considered desirable for beef production with the highly improved breeds of British origin.

The experimental program at the U. S. Range Livestock Experiment Station, Miles City, Montana, has shown that material increase in yield of beef per animal unit can be achieved by application of proper breeding methods. Among four herds of Hereford cattle an increase of as much as 12 percent in feed lot gains was observed in the steer calves of one sire over those of another. A system of crisscrossing using Hereford, Shorthorn, and Angus breeds at the same station showed that the crossbred steers were heavier at the same age, more uniform, dressed higher, and sold for more per hundredweight than purebred steers. The results indicate that crossbreeding offers a means of increasing production per animal unit by approximately 10 percent.

Results at the Jeanerette, La., Station definitely show the advantage of Brahman crossbred types for beef production in the Gulf Coast Region. The use of the Brahman blood in the cattle makes possible the use of large areas of the region that heretofore were considered undesirable for beef production. In performance studies, the 1/4 Brahman 3/4 Angus steers were more efficient in gain and produced higher grading carcasses than the other types studied. These crossbreds are being used to develop a type of cattle particularly adapted to the environmental conditions of the region.

Experiments on artificial insemination with range cattle were continued in cooperation with the University of Missouri and the Indian Service, Department of the Interior. In one range project a total of 430 cows were artificially inseminated during a period of 57 days, 200 of them to one outstanding sire. In another range project, 470 cows were bred to one bull during a 4-month breeding season. Approximately 80 percent calf crops have been obtained for the two previous seasons under range conditions. These results clearly show how it is possible to disseminate superior germ plasma more

widely, after progeny tests have proved the value of a sire. If artificial insemination and performance testing are used together, it is possible materially to improve larger numbers of beef cattle in a comparatively short period of time.

In areas where there is a phosphorus deficiency in the forage, such as frequently occurs in the Gulf Coast States, the use of phosphorus-rich supplements has proved very valuable not only in increasing the calf crop but in insuring more rapid gains of the calves. Supplying phosphorus under the conditions of this experiment has increased the calf crop nearly 30 percent. The heifer calves from supplement-fed cows have weighed approximately 75 pounds more than those from the control cows at weaning time and about 106 pounds more as yearlings at 18 months of age. Only 30 percent of the control cows calved two consecutive years as against about 75 percent for the supplement-fed cows. The increases have more than paid for the bone meal and other phosphates which have been used thus far. The present studies are directed at finding a more simple means of supplying the phosphorus to the cattle. In one method the phosphate is added to the drinking water while in another, phosphate fertilizer is applied to the pastures.

The southeastern states offer several opportunities for augmenting our supplies of beef. Surveys made in the Coastal Plain areas of eastern North Carolina and southern Georgia have focused attention on the feeding problems of cattle raised in forest areas. The winter feed supply is especially critical and the poor condition of the cattle, not only in the early spring, but at other seasons, attest to the likelihood of deficiencies in specific nutrients in the diet. The surveys also brought out the fact that the cattle population in the Coastal Plains is evidently considerably larger than previously indicated. In other words, the cattle industry in this region can be made to supply a good deal more meat than was formerly supposed, and experiments are in progress to find how this can best be done.

The advent of kudzu as an important forage crop in the southern states has appeared to be an excellent feed contribution for livestock production at this time. Cattle feeding experiments the past year indicated that Kudzu hay approaches, although it is perhaps not equal to, alfalfa hay when fed with corn as a fattening ration. This year it is the intention to compare kudzu with lespedeza, which is also a southern crop used for soil conserving purposes. Other work on lespedeza hay, in which barley is the main feed grain, has been conducted in cooperation with the North Carolina Agricultural Experiment Station. Both the lespedeza and the barley are part of a crop rotation being recommended for soil conservation purposes.

Under present and prospective conditions it is essential that we have as complete information as possible on meat preservation and emphasis has been placed on studies of that factor; including dehydration, freezing and freezer storage, and curing. Also, major attention is being given to the quality and quantity of product as affected by certain feeds and rations that are of particular importance at this time. Considering post-war needs, considerable research is also in progress on quantity and quality of beef as related to the breeding of the animal. As in the case of pork, the work on dehydration

is probably the most important line of study under way, in view of the urgent need, both Lend-Lease and military, for dehydrated beef. Research is being conducted to determine practical methods for producing dehydrated beef that is safe as a food and of good keeping quality, palatability, and nutritive value.

Poultry investigations: Methods of increasing the average egg production of chickens through breeding developed at the Beltsville Research Center show that the breeding technique of progeny testing is effective for the establishment and maintenance of the high producing strains. Single-comb Rhode Island Red and Single-comb White Leghorn strains have been developed and maintained with an annual average egg production of 200 eggs per layer. Inbreeding research with Single-comb Rhode Island Red chickens has resulted in the production of outstandingly fecund strains for use in outcrosses. Preliminary tests of crosses in such inbred lines with Single-comb White Leghorns yielded an average annual production of 234 eggs. This is an increase of 34 eggs per year over the production of the parent strains.

The crossing of standard breeds for the production of pullets to be used as layers which has been advocated by many poultry producers has not been found to be a desirable procedure. While the crossbred progeny were superior to the standard-bred stock in rate of growth to 10 and 20 weeks of age, and in viability, they did not excel in egg production largely because the crossbreds had a higher incidence of broodiness.

With the rapid increase in turkey production in the United States, work has continued on the development of a small type turkey of satisfactory weight for general family use. During the year further distribution was made of hatching eggs and poults of the Small White Turkey developed through family selection at the Beltsville Research Center. Eggs or poults have been distributed to more than 35 states and the Territory of Hawaii through state experiment stations and other official agencies during the past two years. This turkey is being accepted by turkey breeders for the production of birds for families that desire a bird weighing 8 to 12 pounds.

An important result of research on endocrine control of egg production has shown that the pituitary product called vasopressin will cause the laying of an egg already covered with shell. Another pituitary hormone, apparently the one called the luteinizing hormone, will cause the shedding of the yolk from the ovary. A complete knowledge of this endocrine mechanism may lead to some form of practical stimulation necessary to remove the egg-a-day limit on egg production.

Research on physiology of reproduction has resulted in the development of a technique whereby a superior male may be mated through artificial insemination to as many as 250 females as compared to the normal 15, thus extending greatly the use of superior lines of breeding stock.

Research on causes and remedies for bacterial contamination and spoilage of shell eggs has shown that soil type bacteria of the *Pseudomonas* group may

penetrate the egg within a very few hours after it is laid, causing the so-called "green rots" which contribute enormously to the bacterial content of dried egg products. It was found that washing such eggs only conceals their suspicious quality and cannot prevent the contamination of egg contents. The best remedy is an insistence that producers have dry yards and clean nests with ample nesting material. Dirty eggs received at the drying plant should be washed and broken immediately before bacterial spoilage has affected their contents. Such washed or dirty eggs should never be held in storage for future breaking operations.

Research on preservation of internal egg quality without refrigeration has shown that the eggs shell-processed with mineral oil 4 to 16 hours after they are laid deteriorate very slowly at room temperature as compared to eggs processed at a later time.

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During the year it was demonstrated that 80 A.O.A.C. chick units of vitamin D per 100 gm. of feed was sufficient to protect growing poultts from rickets. Since many turkey raisers have been using from 2 to 10 times as much of this costly nutrient it is apparent that large quantities have been wasted. Numerous tests also were made of D-activated animal sterol and successful efforts were made to get the food industry to use this new form of vitamin D after normal supplies of codliver oil were cut off by the war.

It was found that codliver oil and some other fish oils contained a factor that hinders the utilization of vitamin D by chickens. This factor is destroyed by heating the oil at 446° F. for 3 hours in a vacuum. Also it was found that these oils contain two factors which influence the color of shanks and skin of yellow-skinned breeds of chickens. These factors are also destroyed by heat in the same manner as the factor that inhibits the utilization of vitamin E.

Coconut palm, peanut, soybean, and hempseed oils when included individually in the diet of laying pullets at a level of 4 percent had no appreciable effect on yolk color, average yolk weight, or average ratio of yolk weight to egg weight. However, cottonseed oil under the same conditions darkened the yolks of the eggs and weakened the yolk membranes to such an extent that they were easily broken and could not withstand the shock when the eggs were broken in the usual manner to remove the contents.

The efficiency of farm poultry production can be greatly increased through the adoption of sound methods of breeding and pullorum disease control. Through these measures and through better care, feeding, and management, average egg production per hen in the United States increased from 89 eggs in 1934 to 101 eggs in 1940. Special efforts on the part of poultrymen in response to the Food-for-Freedom program accomplished a further increase to 110 eggs in 1941. The National Poultry Improvement Plan program, initiated in 1935 and widely adopted as the standard program for organized breeding and pullorum disease control by poultrymen, has contributed greatly to this increase. From 1936, the first year of operation of the plan, through the past three years, participation has increased as follows:

1/ Association of Official Agricultural Chemists

Extent of participation during year ended June 30

Item	1936	1940	1941	1942
	Number	Number	Number	Number
States	34:	44:	44:	44
Hatcheries	1,017:	2,192:	2,465:	2,637
Egg capacity of hatcheries	38,066,000:	90,578,718:	117,915,752:	135,742,179
Breeding flocks	23,813:	50,559:	59,136:	69,681
Breeding birds	3,522,409:	10,714,238:	12,010,766:	15,518,967
Breeding birds tested for	:	:	:	
pullorum disease	2,053,159:	8,990,869:	10,541,695:	14,906,649
U.S.R.O.P. 1/ flock owners	2/ :	335:	335:	317
U.S.R.O.P. flocks	190:	429:	445:	425
Birds entered in trap-nest	:	:	:	
flocks	66,547:	144,447:	154,969:	160,022
U.S.R.O.P. breeding pens ..	2/ :	2,429:	2,749:	2,999
Females in U.S.R.O.P. pens	8,207:	32,949:	38,957:	42,841

1/ U. S. Record of Performance

2/ Complete information not available

A study of the production records of 59,538 pullets trap-nested on U. S. Record of Performance farms during the 1940-41 trap-nest record year shows that the hen-housed average production was 170 eggs. U. S. R.O.P. breeding cockerels are produced in the advanced breeding stage of the plan and are used to mate to carefully selected females in hatching egg supply flocks to improve the quality of chicks through breeding.

Certification of pedigrees of imported registered livestock: During the past fiscal year, a total of 20,247 purebred breeding animals were certified in this project. This is an increase of 1,143 animals as compared with the importations for the previous fiscal year, the principal gains being in the importation of cattle, notably Holstein-Friesians, Jerseys, and Ayrshires. Of the breeding animals certified this year 19,878 came from Canada. The animals certified included 198 horses, 15,933 cattle, 3,634 sheep, 6 goats, 71 swine, and 405 dogs.

(c) DISEASES OF ANIMALS

Appropriation Act, 1943	\$715,000
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Library"	-970
"Salaries and expenses, Office of Administrator,	
Agricultural Research Administration"	-6,000
Total available, 1943	\$708,030
Budget estimate, 1944	706,463
Decrease (including decrease of \$1,192 travel funds	
returned to surplus)	<u>-1,567</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Investigations of brucellosis (contagious abortion) of live- stock	\$221,958:	\$261,572 :	\$261,572 :	--
2. Investigations of infectious diseases of livestock and poul- try caused by bacteria and fungi, other than brucellosis	100,701:	104,814 :	104,814 :	--
3. Investigations of infectious diseases of livestock and poul- try caused by viruses	68,918:	79,660 :	79,660 :	--
4. Investigations of non-infec- tious diseases of livestock and poultry	49,925:	44,735 :	44,735 :	--
5. Investigations of protozoan parasites of livestock and poultry, including coccidiosis	67,658:	65,267 :	65,267 :	--
6. Investigations of worm para- sites of livestock and poultry, such as tapeworms, flukes, and roundworms	66,285:	66,800 :	66,800 :	--
7. Investigations of miscellane- ous parasites of livestock	37,105:	38,930 :	38,555 :	-\$375 (1)
8. Investigations of treatments for parasites of livestock and poultry	44,564:	45,060 :	45,060 :	--
Covered into Treasury in accord- ance with Public Law 674	--:	1,192 :	-- :	-1,192
Unobligated balance	66,414:	-- :	-- :	--
Total estimate 1944 and com- parable amounts 1943 and 1942	723,528:	708,030 :	706,463 :	-1,567

DECREASE

The decrease of \$1,567 for 1944 consists of \$1,192 in travel funds (returned to surplus in 1943) and:

(1) A reduction of \$375 due to the discontinuance of publication pursuant to Office of War Information Regulation No. 3.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item, as follows (new language underscored, deleted matter enclosed with brackets):

Diseases of animals: For scientific investigations of diseases of animals; including the construction of necessary buildings at Beltsville, Maryland, and necessary expenses for investigations of tuberculin, serums; antitoxins, and analagous products, [\$715,000] \$706,463: Provided, That [of said sum \$265,182 may be used for researches concerning the cause, modes of spread, and methods of treatment and prevention of the disease of contagious abortion of animals: Provided further, That] fees shall be charged for all diagnoses in connection with rabies, except those performed for agencies of the United States Government, in such amounts as the Secretary [of Agriculture] shall prescribe, and such fees shall be covered into the Treasury as miscellaneous receipts.

This change in language eliminates the specific proviso relating to the amount which may be used in connection with contagious abortion of animals, and is recommended in the interest of simplicity. The funds under this appropriation are expended for research work on a number of different diseases. Expenditure records are maintained on a project basis, including a project on contagious abortion of animals, and are shown in the Budget each year.

WORK UNDER THIS APPROPRIATION

Objective: To obtain information leading to measures for the control of the infectious and non-infectious diseases of domestic animals, including poultry, which are of particular importance at the present time; and to develop practical methods of coping with the numerous parasites that produce stunting, unthriftiness, and deaths in livestock and poultry.

The Problem and its Significance: The country's livestock and poultry are subjected to attack by many infective agents classified into three general groups, bacteria, fungi; and filtrable viruses. Losses are also caused by mismanagement and injurious agents such as specific poisons and certain plants. Infection is acquired through direct or indirect contact of healthy with diseased animals or their discharges, through inhalation of contaminated air, ingestion of contaminated feed and water, insect and similar vectors, and accidental or surgical wounds. In certain diseases the infection spreads rapidly so that the whole herd becomes affected within a few days; other infections spread slowly and insidiously. Some diseases lend themselves to control to a greater or less degree by vaccination procedures, while other affections do not readily yield to such measures, and specific treatment, prevention or eradication are indicated. In brief, the problem of disease control involves (1) diagnosis, (2) prevention by sanitary measures, and (3) vaccination and eradication. Some of the diseases occasion exceedingly heavy losses through high mortality and others

are disabling and greatly reduce production or lower ability to perform work. The monetary loss resulting from condemnation of whole carcasses or parts of diseased animals slaughtered under Federal or other official meat inspection regulations is conservatively estimated to amount to many millions of dollars.

Livestock and poultry are affected by external and internal parasites that are acquired through (1) the contamination of pastures, dry feed, and water with the infective stages; (2) through swallowing of insects and other low forms of life in which the infective stages normally live; (3) through insects that sting or bite the skin and thereby introduce parasitic infection; and (4) through direct contact of healthy animals with those that are parasitized. Once introduced into a herd or flock parasites multiply at enormous rates and produce stunting, unthriftiness, and death losses. It has been the common experience of livestock producers that farm animals cannot be raised successfully without resorting to periodic drenching or other treatment with medicinal preparations and making provisions of some sort for rotation or other methods of controlling stomach and intestinal threadworms, tapeworms, lungworms, nodular worms, liver flukes, coccidia and other minute protozoan parasites. Experience has shown that enormous quantities of feed are wasted annually in unsuccessful attempts to fatten parasitized stock and poultry. A considerable part of the condemnation of carcasses and parts under meat inspection procedure is due to parasitic invasion, and among the most serious injuries to hides are those inflicted by various external parasites.

General Plan: Investigations are made into methods of diagnosis, cause, mode of transmission, and methods of prevention, treatment, and control of the more important infectious and non-infectious diseases of livestock including poultry. These investigations embrace field and laboratory activities. Studies of the diseases as they exist in the field are made, and the bacteriological, serological, pathological, immunological, and animal inoculation studies are conducted in the laboratory.

To develop a practical and scientific basis for eradicating or controlling parasites, studies are conducted on the distribution of these pests in the major agricultural regions of the United States, these investigations taking into consideration climate, soil types, pastures, and topography; methods are developed for accurate diagnoses; the infective stages are investigated with view to developing methods for their destruction; the mode of transmission is determined by experiments in the laboratory and observations in the field; the injuries produced and symptoms exhibited by experimentally-infected animals are noted in order to develop sound methods for field diagnosis; the immunological responses, if any, are investigated as aids in control; weak links at which the vicious cycles of parasites may be broken are explored; intermediate hosts are investigated and methods are devised for their eradication or control; field tests to develop promising control measures are conducted on a small scale under conditions that enable the investigators to determine the factors that might be involved; and, finally, the most promising control measures are tested in the field in cooperation with farmers and stockmen, and control measures are adapted to meet varying conditions existing in different parts of the country.

To meet the ever-pressing need for affording infected animals prompt relief from the drain of parasitic infestations and saving the lives of young animals that have but little resistance to cope with mass attacks by parasites, experiments are conducted with drugs and chemicals to determine effective and inexpensive methods of detroying external parasites on, and removing internal parasites from, livestock and poultry. Investigations are conducted also to develop practical methods of destroying the infective stages of parasites in the manure, which is the most fertile source of parasitic infestation on the farm and range.

Examples of Progress and Current Program: The following examples of recent accomplishments and aspects of the broader problems involved are cited by projects.

Investigations of brucellosis (contagious abortion) of livestock: A very important research problem was concluded during the past year in which it was shown through serial passage in pregnant cows, that strain 19, an organism of reduced virulence used in the preparation of vaccine against brucellosis of cattle, commonly known as Bang's disease, was stationary and could not be returned to its original full virulence. Another factor of extreme importance in this same experiment was that normal pregnant cows kept for a period of two pregnancies in close cohabitation with the cows on which the above-mentioned experiment was conducted remained free from infection. These findings show that strain 19 is safe for vaccinal purposes and indicate that the use of strain 19 vaccine in herds free from infection, as insurance against infection, is not impractical.

In September 1941 a Bureau representative, on request of the British Government, visited England to confer with officials of that country on the control of animal diseases under war conditions. This conference was especially significant in connection with Bang's disease which has an extensive foothold in the British Isles and is a very serious factor in limiting the supply of milk and calf production, due to abortion, and in causing sterility. As a result of this conference, another investigator from this Bureau was sent to England in February 1942 for a period of five months to assist the British officials in setting up a strain 19 vaccine laboratory in England.

Cooperative work on swine brucellosis was begun during the past year and five state experiment stations have been assigned studies in connection with it. The results so far accomplished are inconclusive but many minor factors have been uncovered which indicate that brucellosis of swine differs from the bovine type of brucellosis in many respects and that each factor must be made the subject of careful study before acceptable control methods can be advocated.

Investigations of infectious diseases of livestock and poultry caused by bacteria and fungi, other than brucellosis: An experiment of several years' duration in which hogs were placed in close contact with tuberculous chickens resulted in almost 100 percent of the hogs becoming infected in a year's time. The chickens were removed and subsequently the adult hogs were

tested and removed yearly when the young pigs were weaned. This resulted in the elimination of tuberculosis in the swine in two generations. All hogs have now been removed from these premises and 100 normal chickens placed in this very unsanitary enclosure to determine if virulent avian tubercle bacilli still persist in the soil in sufficient numbers to affect poultry.

Scarcity of some of the ingredients used in the preparation of tuberculin (the diagnostic agent used in the detection of tuberculosis of cattle), particularly asparagin, has necessitated the development of possible substitutes. Ammonium malleate and ammonium glutamate have been used with encouraging results. Tests on the potency and reliability of such tuberculins are in progress.

During the past year the chief efforts in the study of bovine mastitis have been centered on the testing of various drugs or disinfecting agents which have recently been advocated for the treatment of streptococcal mastitis. This work has been done in conjunction with the Maryland State Agricultural Experiment Station and is still in progress. The four agents used in this work are acriflavine, entozon, tyrothricin, and Novoxil (colloidal silver oxide).

Six herds, previously determined by test as being affected with streptococcal mastitis, were selected for this purpose. Although the results from the use of these agents are promising, the number of animals treated is too small to permit formulation of definite conclusions as to their ultimate value. In a few cases, some injury to the udder resulted even when the infection had been overcome. In some of the treated quarters in which the infection caused by *Streptococcus agalactiae* was cured, there developed a secondary mastitis due to infection with certain types of staphylococci. Treated herds should be examined at regular intervals following treatment to check upon the permanence of the cure and the effect of treatment on milk production.

During the fiscal year 1942 the project on the efficacy of the culture-serum method of immunization for the control of swine erysipelas was expanded, 995,308 hogs being treated. The results were generally satisfactory. This project is being conducted on an experimental basis in Illinois, Iowa, Missouri, Nebraska, and South Dakota. From July 1, 1941, to April 1, 1942, the vaccine was prepared at the branch pathological laboratory at Lincoln. Because of the heavy demand for the vaccine brought about by the expansion of the experimental work, permission has now been given by the Bureau to a number of commercial laboratories to prepare the product under a limited license.

The Bureau continued to receive favorable reports on the use of the agglutinating fluid for the diagnosis of swine erysipelas, developed several years ago. The test is receiving practical application by veterinarians in the field and by laboratories.

Studies on paratyphoid infection, particularly with *Salmonella choleraesuis*, were continued. Experiments were carried out to determine the nature of the

infection as a specific entity in normal swine, its relation to hog cholera immunization, and its manner of manifestation in pigs affected with nutritional deficiencies. Under the conditions of the test made, the *Salmonella choleraesuis* organism when fed, was capable of producing either an acute disease terminating in a septicemia and death, usually within 3 or 4 days to a week, or a chronic form characterized by general unthriftiness, loss of weight, and often terminating in a necrotic enteritis. In one test when *Salmonella choleraesuis* was fed to normal shots the day previous to simultaneous treatment with hog cholera virus, an acute disease developed, which terminated fatally within a week, whereas hogs fed the culture of *Salmonella choleraesuis* alone developed a chronic form of the disease, indicating the hog cholera vaccination with serum and virus in hogs carrying this organism may be followed by severe losses.

In the control of pullorum disease of poultry, main reliance is placed on the detection of carriers of the disease through the agglutination test and eliminating them from the breeding flocks. Refinements made in the testing fluid resulted in a more suitable product, the T. G. antigen, which has been used in the past year with reported favorable results. Studies on the further improvement of the antigen are in progress. The use of elemental sulphur instead of sodium thiosulfate has afforded appreciably increased yields, but a satisfactory method of adding the sulphur to the media has not as yet been found. Pullorum disease of turkeys is of serious consequence in many sections of the country. The detection of the disease in turkeys by the agglutination test is not so reliable as it is in chickens. Efforts to develop a satisfactory antigen for turkeys are still in the experimental stage, and different antigens are being tried out in the laboratory and in the field.

Investigations of infectious diseases of livestock and poultry caused by viruses: In previous years only western equine encephalomyelitis virus was found in Texas; this year the highly virulent eastern type was recovered. Similar studies of Maryland cases yielded the eastern type virus, and the milder, yet much more widely distributed, western type virus was identified from a Michigan specimen. These studies determine the existing type of virus in a locality and permit application of vaccine of the homologous type, which is necessitated by lack of cross immunity between the two types of the disease. So far the virus of St. Louis encephalitis has not been recovered from specimens sent in from the field. Tests were completed that corroborated the findings of other investigators that the horse is susceptible to St. Louis encephalitis virus. Tests in horses also showed that there is no immunologic relationship between St. Louis encephalitis virus and the virus of equine encephalomyelitis.

In the experimental work with hog cholera more than 100,000 cc. of crystal violet vaccine were distributed for field tests to veterinarians in 8 states. During the year 257 herds, comprising 8,578 hogs, were reported to have been treated in the general field test of crystal violet vaccine. Twenty-nine herds, containing about 1,120 hogs, were reported to have been exposed during the year to cholera and about 85 percent of these were found to be

adequately protected. To date more than 13,000 hogs have been treated in the general field test and of those reported to have been exposed to cholera about 80 percent appeared to be adequately protected.

In the investigations of swamp fever further transmission experiments with insects demonstrated that an inapparent form of the disease could be transmitted from infected to healthy horses by the bites of at least one species of mosquitoes (*Psorophora columbiae*) or by injections of extremely minute amounts of the virus. Attempts to transmit the disease to large domestic animals other than equines and to various species of laboratory animals were uniformly negative. In studies on the congenital transmission of the disease, evidence was obtained that the semen of an infected stallion contained the virus.

Rabies continues to be a disease of economic and public health importance in the United States. In 1941 there were reported to the Bureau 6,648 cases in dogs, 418 in cattle, 39 in horses, 68 in sheep, 159 in swine, 294 in cats, 1 in goats, 212 in miscellaneous animals, 30 in man, making a grand total for the country at large of 7,877 cases. This is considered to be a very conservative figure of the death loss occasioned by this disease. Under this project, attention is given to the improvement of methods of testing rabies vaccines in order that only the most effective products will be marketed for use in the field. Information is collected on the disease as it exists in the field and assistance is given to a national committee composed of representatives of various organizations looking to the control of the disease on a Nation-wide basis.

The avian-leukosis complex, commonly known as range paralysis, comprises a number of manifestations in poultry in which there is a common pathologic cell; (1) the neural type of the disease (fowl paralysis); (2) the blood type (leukosis); (3) a replacement of the pigment of the eye with leukotic cells (gray eye); and (4) the visceral type (big liver disease). Although the exact cause of this disease is not yet known, during the past year marked progress has been made through the increased virulence of the leukotic agent strain A as a result of serial passage through chick embryos and baby chicks. This increase in virulence of the leukotic agent has furnished a tool for the development of both a diagnostic agent and an immunologic procedure. Work is being done on the preparation of a vaccine and a study of the relationship of the various forms of the disease is under way.

Investigations of non-infectious diseases of livestock and poultry:
Field investigations of reported livestock losses from plant poisoning, the experimental feeding of suspected plants, and a study of treatment and methods of prevention of poisoning by plants were continued. Experimental feedings were conducted on 12 suspected plant species. Nine of the plants were found to be definitely toxic and the cause of livestock losses; three were non-toxic under experimental conditions. One of the three non-toxic plants, Astragalus cicer, was fed at the request of the Soil Conservation Service to determine its character as a forage plant and to avoid the

introduction of a poisonous species on the range. The other two were collected in Idaho and in Utah. In studying the effect of frost on the hydrocyanic content of sorghum, it was shown that there may be an increase or decrease in hydrocyanic content on freezing. This is influenced by the variety of plant and severity of the frost.

Vitamin A deficient animals have been observed to develop a characteristic swelling of the legs, brisket and shoulders. It has been ascertained with a reasonable degree of certainty that the large number of cases of generalized edema among carcasses of fat cattle slaughtered at midwestern packing plants during the past year is due to a deficiency of vitamin A in the diet. Many such carcasses are condemned as unfit for food. This deficiency has occurred principally among cattle fattened on yellow corn, with or without a protein-rich concentrate, and low-grade hays or straw as the main roughage. When the rations were supplemented with new well-cured alfalfa hay the cattle usually improved rapidly, the swelling disappeared in a few weeks, and the animals sold without loss. Laboratory studies indicate that feeding supplements of carotene, or vitamin A, may correct this condition.

Necrotic enteritis is a swine disease which causes considerable losses among young pigs. Recently there has been a growing belief that the disease is closely associated with diet. Accordingly, it has seemed highly desirable to supplement the existing work of the Bureau on the infectious nature of the disease with an investigation of the nutritional deficiency aspects in order to permit a thorough and well directed attack on the problem. In experiments initiated during the fiscal years 1941 and 1942, deficiency of nicotinic acid seemed significantly to increase the susceptibility of young pigs to *Salmonella choleraesuis*, the organism held to be responsible for necrotic enteritis, while pigs similarly fed but with nicotinic acid added to their diet were able to withstand the harmful effects of the *Salmonella* organism.

Investigations of protozoan parasites of livestock and poultry, including coccidiosis: Previous experiments having shown that horse flies could transmit anaplasmosis from sick to susceptible cattle, 4 rigidly controlled tests were made to determine whether these flies could also transmit the disease from carrier animals to susceptible ones. The results showed that horse flies are not responsible for the spread of anaplasmosis in herds where only carrier animals are present. Negative results were obtained also in attempts to transmit anaplasmosis by sucking lice, which are quite prevalent on cattle during the winter months. It was definitely determined that the marginal bodies in the red blood cells, on the basis of which a diagnosis of anaplasmosis is made, are actually the cause of anaplasmosis. By hemolyzing red blood cells and thereby liberating the marginal bodies, the disease could be produced in susceptible animals into which they were injected. In preliminary studies it was determined that the mortality from anaplasmosis could be reduced by injecting whole or citrated blood into sick bovines when it appeared certain that the crisis could not be passed without this aid.

In attempts to develop a rapid test for diagnosing trichomoniasis in bovines--a venereal disease responsible for delayed conception, abortion,

and a diseased condition of the uterus--it was determined that a positive diagnosis with the aid of a microscope could be made with greater certainty during the third week following service than at any other time; another favorable period for diagnosis is shortly before estrus. In experiments to determine whether cows previously infected are still susceptible to trichomoniasis, it was found that, on the whole, infected bulls may be used with fair success on previously infected cows. It was ascertained, moreover, that a large percentage of bulls are refractory to infection even after repeated exposure, this condition being responsible apparently for checking the disease and keeping it from occurring in widespread form.

Sulfaguanidine in 3-gram doses per lamb daily showed exceptional promise in preventing coccidiosis. Since sulfaguanidine is too expensive at present for use in sheep, tests were made with ordinary flowers of sulphur admixed with the feed and the results so far obtained showed that the medicated feed has distinctive preventive efficacy. Clinical coccidiosis did not develop in lambs receiving sulphur mixed with the feed in the proportion of 0.5, 1, and 1.5 percent by weight, whereas in lambs not receiving sulphur well-marked coccidiosis developed. From 1 to 2 percent sulfaguanidine incorporated in the mash protected chicks from cecal coccidiosis, the most virulent form of this disease. Even 0.5 percent of the drug incorporated in the mash was sufficient to prevent fatal results. Sulfaguanidine administered as outlined enabled the birds to build up a resistance to coccidiosis which persisted even up to a year.

In investigations on trichomoniasis of the lower digestive tract of turkeys, it was determined that the parasites are transmitted from bird to bird through the accidental ingestion of contaminated droppings, or of feed or water that has become contaminated with them. Birds that developed a chronic form of the disease consumed less feed and, therefore, made average lower weight gains than uninfected controls. Methods of avoiding infection still remain to be determined.

Investigations of worm parasites of livestock and poultry, such as tapeworms, flukes, and roundworms: In experiments on the control of bloodworm in horses by the daily administration in the feed of small quantities of phenothiazine, it was found that with this regime of therapy, lasting over a period of 10 weeks, the parasites were gradually eliminated and the eggs that they discharged with the droppings failed to produce live larvae, the latter having been killed by the small traces of phenothiazine in the droppings. The small doses of the drug administered produced no toxic manifestations.

Investigations on nodular worms of sheep showed that affected animals lost considerable weight and produced less wool than uninfected ones, the wool fibers showing breaks, discoloration, and reduction in diameter. The affected animals showed loss of appetite and developed anemia and diarrhea. The intestines were studded with nodules which rendered them unsuitable for use in the manufacture of catgut sutures that have now become strategic material. It was determined, moreover, that the infective larvae of these

parasites do not survive in appreciable numbers during the winter months. A method of control has been formulated, namely, treatment of the breeding stock during the winter, in order to prevent the contamination of the pastures in the spring--the source of infection for the lamb crop.

In about 21,000 sets of sheep intestines examined in Chicago to determine the areas in the United States where nodular worm disease is most prevalent, it was found that this disease occurs in the Middle West and the Southwest, but is apparently rare or absent in the Rocky Mountain States and in the Pacific Coast area. The intestines of sheep affected with this disease are condemned for use as sausage casings, as well as being unsuitable for surgical sutures.

In investigations on swine parasites it was found that the small intestinal threadworms produce morbidity and mortality in pigs because they penetrate the heart muscle, a habit of these parasites not previously reported in the literature. Suckling and young pigs generally are especially susceptible. Pigs on pasture seldom acquire these parasites in sufficient numbers to produce injury.

Investigations on liver flukes in the Gulf Coast area of Texas showed that 42 percent of the adult cattle, 7.5 percent of the calves, and nearly all sheep are parasitized. In preliminary trials hexachlorethane proved to be a promising medication, doses of 80 to 100 grams per animal removing the vast majority of the parasites. In most instances the drug was nontoxic and safe for use.

In investigations on worm parasites of chickens it was determined that these pests regarded the growth of baby chicks regardless of the diet administered, but retardation was not as marked in birds kept on a high protein diet as in those kept on a low protein diet. Phenothiazine in 4 successive daily doses of 0.5 gram proved highly effective in removing cecal worms.

Investigations on miscellaneous parasites of livestock and poultry: In investigations on trichinosis in swine it was determined that the skin test is not applicable to the diagnosis of this disease because of a skin sensitivity of pigs to the diluents in which the trichina antigen is dissolved or suspended. Although all pigs are skin sensitive, those fed on garbage are more sensitive than those fed on grain. About 10 percent of rats and 1 percent of mice trapped in packing houses in Chicago harbor trichinae. The role of these rodents in the transmission of trichinae to swine has not been definitely ascertained.

Current reports of investigations the world over on methods of controlling and preventing infestation with livestock parasites were indexed and information on treatment was abstracted in order to make the results available to our farmers and stockmen in connection with increased livestock production. A bibliography was compiled on the occurrence of hydatid cysts, tape-worm parasites of dogs, the cystic stage of which occurs in human beings and livestock. The disease which these cysts produce (hydatid disease) is prevalent in Iceland and Australia and information on this point was furnished,

upon request, to medical officers of the Army and Navy. Considerable bibliographic research was done to compile information on critical materials used as parasitocides and available substitutes for them. Information on these points was furnished to the War Production Board, and other government agencies directly concerned with the war.

Dips containing derris powder or cube powder were tested for the destruction of cattle grubs in Colorado and the results showed that approximately 93 per cent of the grubs harbored were destroyed by a single dipping when the cattle were held in the swim for about 2 minutes. Dips containing about 4 ounces of derris powder to 100 gallons of water were effective in destroying sheep ticks following a single dipping.

Preliminary investigations showed that salt medicated with phenothiazine and kept before sheep at all times was quite effective in controlling stomach worms, nodular worms, and related internal parasites of sheep. The sheep exposed to the medicated salt lost their parasite burden, made better weight gains, and produced more wool than comparable controls. In experiments on treatment of pregnant ewes with phenothiazine for the control of nodular worms, it was determined that the administration of this drug with the feed was a satisfactory way to remove the adult parasites. The treatment produced no ill effects on the pregnant ewes. Phenothiazine was found to be as effective in removing stomach worms from goats as from sheep.

In tests with a large number of miscellaneous substances to develop substitutes for drugs that have become critical materials, one substance obtained from oil of rose geranium proved to be highly effective for the removal of hookworms from dogs with an indication that it might be of value also in treating other animals for the removal of internal parasites.

(d) ERADICATING TUBERCULOSIS AND BANG'S DISEASE

Appropriation Act, 1943	\$3,575,669
Proposed transfer in 1944 estimates to "Salaries and expenses, Office of Secretary of Agriculture"	-1,800
Total available, 1943	3,573,869
Budget estimate, 1944	5,983,800
Increase in the direct appropriation to replace reappropriated funds available in 1943 (including decrease of \$53,400 travel funds returned to surplus)	+2,409,931

(a) Together with \$1,450,000 of the unobligated balance under this appropriation for the fiscal year 1940, and \$1,013,331 of the unexpended balances of appropriations heretofore made for "Eradication of Foot-and-Mouth and Other Contagious Diseases of Animals."

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Eradicating tuberculosis in livestock (including poultry)	\$1,484,435	\$1,480,000	\$1,480,000	- -
2. Eradicating Bang's disease in cattle	4,679,414	4,503,800	4,503,800	- -
Covered into Treasury in accordance with Public Law 674	- -	53,400	- -	- 53,400
Unobligated balance	198,607	- -	- -	- -
Total available	6,362,456	6,037,200	5,983,800	-53,400
Reappropriation of prior year balance	-750,000	-2,463,331	- -	+2,463,331
Total estimate 1944 and comparable amounts 1943 and 1942	5,612,456	3,573,869	5,983,800	+2,409,931

INCREASE

The net increase of \$2,409,931 in the direct appropriation for 1944 consists of \$53,400 decrease in travel funds (returned to surplus in 1943) and:

(1) An apparent increase of \$2,463,331 in the direct appropriation to offset a decrease in reappropriated funds in the same amount. There is no change in the available working funds for this project, other than the travel decrease.

Tuberculosis eradication has been in progress since 1917. During the fiscal years 1935 to 1939, inclusive, regular and special funds (Jones-Connally and Section 37, Act of August 24, 1935) were used for this purpose. Bang's disease eradication was inaugurated in the fiscal year 1935, and this work was financed exclusively with special funds through the fiscal year 1938. Since 1939 the Agricultural Appropriation Act has provided for continuation of tuberculosis and Bang's disease eradication under one consolidated appropriation item entitled "Eradicating tuberculosis and Bang's disease."

Table I, which follows, shows the direct appropriations, reappropriations of regular and special funds, and net availability under the consolidated item.

TABLE I.

STATEMENT OF DIRECT APPROPRIATIONS, REAPPROPRIATIONS OF REGULAR AND SPECIAL FUNDS, AND NET AVAILABILITY UNDER "ERADICATING TUBERCULOSIS AND BANG'S DISEASE," FISCAL YEARS 1939-1944.

Fiscal year	Direct appropriation	Reappropriation	Total appropriation	Amount reappropriated: in subsequent years	Net availability
1939	\$5,403,000	\$7,827,000 <u>1/</u>	\$13,230,000	\$4,000,000	\$9,230,000
1940	8,300,000	4,000,000 <u>1/</u>	12,300,000	5,450,000	6,850,000
1941	4,300,000	4,000,000 <u>1/</u>	8,300,000	750,000	7,550,000
1942	5,598,140	750,000 <u>2/</u>	6,348,140	- -	6,348,140
1943	3,575,669	2,463,331 <u>3/</u>	6,039,000	- -	6,039,000
1944 est.	5,983,800	- -	5,983,800	- -	5,983,800

1/ Estimated unexpended balance of special funds (Jones-Connally and Section 37, Act of August 24, 1935).

2/ Unobligated balance of 1941 funds under this head.

3/ \$1,450,000 unobligated balance of 1940 funds under this head and \$1,013,331 unexpended balances of appropriations heretofore made for "Eradication of Foot-and-Mouth and Other Contagious Diseases of Animals".

Table II, which follows, shows, by states and territories, the allotments of funds for tuberculosis and Bang's disease during the fiscal year 1943.

TABLE II

ERADICATING TUBERCULOSIS AND BANG'S DISEASE

1943 Allotments

State	Eradicating tuberculosis		Eradicating Bang's disease		Total
	Salaries :	Indemni-	Salaries :	Indemni-	
	and expenses :	ties :	and expenses :	ties :	
Alabama	\$19,500 :	\$500 :	\$75,000 :	\$60,000 :	\$155,000
Arizona	3,000 :	2,000 :	16,000 :	4,000 :	25,000
Arkansas	4,000 :	- - :	70,000 :	25,000 :	99,000
California	115,000 :	40,000 :	- - :	- - :	155,000
Colorado	14,000 :	2,000 :	17,000 :	- - :	33,000
Connecticut	14,000 :	11,000 :	2,500 :	14,500 :	42,000
Delaware	3,500 :	1,500 :	10,000 :	16,000 :	31,000
District of Columbia	44,500 :	- - :	120,000 :	- - :	164,500
Florida	9,500 :	500 :	60,000 :	45,000 :	115,000
Georgia	5,000 :	- - :	57,000 :	38,000 :	100,000
Idaho	5,500 :	500 :	40,000 :	30,000 :	76,000
Illinois	22,000 :	53,000 :	41,000 :	65,000 :	161,000
Indiana	35,000 :	5,000 :	19,000 :	- - :	59,000
Iowa	28,000 :	85,000 :	72,000 :	250,000 :	435,000
Kansas	20,000 :	5,000 :	42,000 :	3,000 :	70,000
Kentucky	16,000 :	1,400 :	25,000 :	10,000 :	52,400
Louisiana	14,000 :	2,000 :	45,000 :	20,000 :	81,000
Maine	12,000 :	2,000 :	30,000 :	115,000 :	159,000
Maryland	47,000 :	7,000 :	35,000 :	95,000 :	184,000
Massachusetts	18,000 :	13,000 :	- - :	- - :	31,000
Michigan	20,000 :	7,000 :	73,000 :	61,000 :	164,000
Minnesota	21,000 :	5,000 :	132,000 :	95,000 :	253,000
Mississippi	15,500 :	500 :	40,000 :	20,000 :	76,000
Missouri	16,000 :	500 :	63,000 :	35,000 :	114,500
Montana	18,500 :	500 :	8,000 :	4,000 :	31,000
Nebraska	20,000 :	1,000 :	40,000 :	11,000 :	72,000
Nevada	4,800 :	200 :	8,000 :	- - :	13,000
New Hampshire	9,000 :	3,000 :	18,000 :	77,000 :	107,000
New Jersey	13,000 :	13,000 :	10,000 :	30,000 :	66,000
New Mexico	2,500 :	500 :	28,000 :	5,000 :	36,000
New York	43,000 :	70,000 :	13,000 :	54,000 :	180,000
North Carolina	8,500 :	500 :	30,000 :	17,000 :	56,000
North Dakota	25,000 :	1,000 :	70,000 :	29,000 :	125,000
Ohio	31,000 :	9,000 :	47,000 :	105,000 :	192,000
Oklahoma	10,500 :	500 :	52,000 :	- - :	63,000
Oregon	14,000 :	5,000 :	66,000 :	55,000 :	140,000
Pennsylvania	38,000 :	53,000 :	76,000 :	410,000 :	577,000
Rhode Island	8,000 :	2,000 :	100 :	4,900 :	15,000
South Carolina	6,500 :	500 :	20,000 :	3,000 :	30,000

TABLE II

ERADICATING TUBERCULOSIS AND BANG'S DISEASE - Continued

State	Eradicating tuberculosis		Eradicating Bang's disease		Total
	Salaries and expenses	Indemnities	Salaries and expenses	Indemnities	
South Dakota	\$68,000	\$5,000	\$22,000	\$3,000	\$98,000
Tennessee	22,100	900	27,000	38,000	88,000
Texas	29,000	2,000	31,000	- -	62,000
Utah	11,000	5,000	35,000	13,000	62,000
Vermont	8,000	6,000	20,000	1,000	35,000
Virginia	21,000	5,000	45,000	75,000	146,000
Washington	23,000	3,000	80,000	102,000	208,000
West Virginia	15,000	1,000	46,000	18,000	80,000
Wisconsin	47,000	14,000	100,000	417,800	578,800
Wyoming	3,600	400	19,200	800	24,000
Alaska	- -	100	- -	- -	100
Hawaii	1,500	500	- -	- -	2,000
Puerto Rico	21,500	10,000	8,000	22,000	61,500
	1,045,000	435,000	2,003,800	2,500,000	5,983,800

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item as follows: (new language underscored, deleted matter enclosed with brackets):

Eradicating tuberculosis and Bang's disease: For the control and eradication of the diseases of tuberculosis and paratuberculosis of animals, avian tuberculosis, and Bang's disease of cattle, [\$3,575,669, together with \$1,450,000 of the unobligated balance of the appropriation made under this head for the fiscal year 1940, and \$1,013,331 of the unexpended balances of appropriations heretofore made for eradication of foot-and-mouth and other contagious diseases of animals, in all, including reappropriations, \$6,039,000] \$5,983,800:
 Provided, That*****

This change eliminates the reappropriations of funds provided in the 1943 Act. Since July 1, 1934, both regular and special funds (Jones-Connally and Section 37, Act of August 24, 1935) as well as reappropriations of unobligated balances of these funds, have been available for eradicating tuberculosis and Bang's disease. The last reappropriation of unobligated balances of special funds was in the fiscal year 1942. An unobligated balance of \$1,450,000 of regular funds provided in the 1940 Agricultural Appropriation Act, together with \$1,013,331 of foot-and-mouth funds, was provided in the Agricultural Appropriation Act for the fiscal year 1943, which it is expected will be fully obligated. The 1944 estimate is for a direct appropriation in the full amount needed.

WORK UNDER THIS APPROPRIATION

Objective: The work under this appropriation provides for the eradication of tuberculosis in livestock (including poultry), paratuberculosis in cattle, and Bang's disease (brucellosis or contagious abortion) in cattle, with partial compensation to owners of cattle condemned and destroyed because of being affected with the diseases.

The Problem and its Significance: Tuberculosis, when present, is one of the most serious diseases of cattle, swine, and poultry, because of its effect in reducing production and causing a considerable loss of meat condemned as unfit for food. Notwithstanding the great progress made in stamping out this disease, it is reliably estimated that an annual loss of \$10,000,000 can be attributed to it, \$5,500,000 of which is borne by the poultry industry, \$2,000,000 by the swine industry, and \$2,500,000 by the cattle industry. In swine it may progress to a point where it becomes generalized, but in most of the carcasses showing evidence of the disease on post-mortem examination, only slight lesions are found. Avian (fowl) tuberculosis is particularly difficult to eradicate because of the fact that the organisms are so resistant and live for many months in the soil.

Bang's disease is found among cattle in practically all sections of the United States, although the degree of infection is much greater in some localities than in others. In those sections where there has been a considerable exchange of cattle, a high degree of infection is found. This condition also obtains in and around the large milk-shed areas. It is conservatively estimated that this disease is responsible for an annual loss of \$30,000,000 to our livestock industry. Approximately 75 percent of all breeding trouble in cattle is caused by this disease. Common results of the infection are premature birth of calves and sterility.

General Plan: Eradication work is conducted in cooperation with livestock sanitary officials of the various states, and is governed by state laws and regulations. Tuberculosis eradication is carried on under the test-and-slaughter plan, but cooperating states may elect one or more of the three plans for Bang's disease eradication--test-and-slaughter plan, calfhood vaccination, or a combination of the two.

Under the test-and-slaughter plan, tests are applied to the cattle by veterinarians employed by the Bureau, states and counties, and by practicing accredited veterinarians, to detect the existence of any infection in the living animal. Reactors are appraised at their market value, taking into consideration their quality as breeding and dairy animals, after which they are slaughtered under supervision. In addition to their salvage value, the owner receives from the Federal Government one-third of the difference between the appraised value and the salvage, not to exceed \$25 for grade animals and \$50 for registered purebred animals. Federal payment is further limited to an amount not exceeding that paid by the cooperating state, county, and municipality. Payment from all sources, including the salvage, cannot exceed the appraised value of the animal.

Under the calfhood vaccination plan, all cattle over 6 months are usually tested. The vaccination of animals is confined to calves between 4 and 8 months of age, 6 months being the preferable age. The age and date of vaccination of each animal is properly recorded, and the identity of each animal definitely established. Animals in herds in which vaccination is practiced are not to be disposed of, except for immediate slaughter, without written permission of the cooperating state or Bureau officials. A herd under the vaccinal plan may be certified as a "Herd Free of Brucellosis" for a period of 1 year when all animals in the herd over 2 years of age reveal at least 2 negative reactions to official blood agglutination tests, properly spaced, and the vaccinated animals under 2 years of age show a satisfactory blood titer. The payment of Federal indemnity for adult cattle in such herds that react to the test depends upon the circumstances in the individual states.

As stated above some states employ a combination of the test-and-slaughter plan and calfhood vaccination plan, the owner selecting which plan is to be adopted. Inasmuch as the success of any eradication plan depends, to a large extent, upon the conditions prevailing in the individual states the Bureau has taken such conditions into consideration in the officially recognized plans.

Supervision is maintained over the disposition of reactors which have been consigned to public stockyards for slaughter, and over the testing at such stockyards of cattle to be shipped interstate for dairy or breeding purposes.

In combating avian tuberculosis, the veterinarians employed in the field cooperate with the local livestock sanitary officials and the owners of poultry flocks. Cooperation is also obtained from certain local organizations and owners of hatcheries.

Examples of Progress and Current Program:

Eradicating tuberculosis in livestock (including poultry): Since the inauguration of the cooperative tuberculosis eradication work in 1917, there has been a very marked reduction in the degree of infection of tuberculosis. At the beginning of the campaign approximately 5 percent of the cattle tested disclosed infection, whereas during the fiscal year 1942 less than three-tenths of 1 percent reacted to the test. Every county in every state the District of Columbia, Puerto Rico, and the Virgin Islands, are now listed as modified accredited areas. Since the cooperative work was undertaken, through the fiscal year 1942, approximately 252,926,000 tuberculin tests have been applied to cattle, disclosing about 3,837,000 reactors.

During the fiscal year 1942 the average appraisal of reactors was \$109.69; the average salvage, \$50.35; the average state indemnity, \$21.49; and the average Federal indemnity, \$16.55. It will thus be noted that on an average appraisal of \$109.69, the owner received from all sources for his tuberculous animals a total of \$88.39. On June 30, 1942, 6,320,066 herds, containing 63,073,213 cattle were under supervision for the eradication of tuberculosis.

During the past year the field veterinarians engaged in tuberculosis eradication work observed approximately 87,000 flocks, containing about 11,738,000 fowls located in 10 states. About 18 veterinarians of the Bureau devoted practically their entire time to the avian tuberculosis project, visiting 10,115 farms, and observing 1,833,181 fowls. Infection was reported on 1,628 farms.

Paratuberculosis, or Johne's disease, exists to some extent among cattle in the United States. While this is a difficult disease on which to make a diagnosis, 5,178 cattle were tested during the past year, disclosing 437 reactors, or 8.4 percent.

All the tuberculin used in this work is prepared by the Bureau. During the past fiscal year approximately 1,035,000 cc of this product were used in the work.

Eradicating Bang's disease (Brucellosis) in cattle: Since the cooperative campaign for the eradication of Bang's disease in cattle was undertaken in July 1934, very satisfactory progress has been made. The incidence of this disease among the dairy and beef cattle of this country has been reduced from approximately 10 percent when the project was started to about 4.5 percent. There is a great demand on the part of the cattle owners that the work continue. In 13 states more than 50 percent of the breeding cattle over 6 months of age are under supervision. During the 8 years in which this work has been conducted, agglutination blood tests, including retests, have been applied to approximately 54,736,000 cattle, of which about 2,343,000 have been classed as reactors.

Soon after the beginning of the cooperative campaign to control and eradicate this disease in cattle, it was decided to inaugurate a plan whereby cattle could be tested on an area basis. In December 1939 a plan was adopted to establish "modified accredited Bang's disease-free area", that is, areas in which cattle infection does not exceed 1 percent and herd infection not more than 5 percent. At the close of the last fiscal year, there were 522 counties in 24 states in this classification. Approximately 4,690,000 dairy and breeding cattle were located in these counties. The area work was being conducted in 186 additional counties. All of the counties in North Carolina, 100 in number, were in the modified accredited Bang's disease-free area on July 1, 1942.

In many of the states the herds of cattle that are entirely free from this disease are given official recognition as state accredited Bang's disease-free herds. At the end of the fiscal year 1942, there were 76,488 herds, containing 1,594,798 cattle, so classified.

During the fiscal year 1942, a total of 6,891,219 agglutination blood tests were applied to cattle, disclosing 209,238 reactors, including 39,586 reactors held in calfhood vaccination herds for which Federal indemnity will not be paid. This is the lowest degree of infection reported since the work began. During the fiscal year 1942 the average appraisal of reactors was

\$99.19; the average salvage, \$52.06; the average state indemnity, \$17.71; and the average Federal indemnity, \$15.83. The owner received from all sources for his Bang's disease reacting cattle an average total of \$85.60. On June 30, 1942, 2,105,294 herds, containing 15,627,027 cattle, were under supervision for the eradication of Bang's disease.

Satisfactory results have continued with calfhood vaccination. This work is conducted under official supervision in 37 states, and some vaccinating is being done in most of the others. From January 1, 1941 to June 30, 1942, approximately 140,000 calves were vaccinated under official supervision.

It is important that careful supervision be given to the testing of the vaccine used in this work. During the last fiscal year, samples of 1,686 hatches of commercially prepared vaccine were tested by the Bureau, 181 of which were found unsatisfactory for vaccinal purposes and were ordered destroyed. Some of the Brucella vaccine used in the official calfhood vaccination work is prepared by the Bureau, as well as all of the antigen used in official Bang's disease testing.

(e) ERADICATING CATTLE TICKS

Appropriation Act, 1943	\$276,000
Budget estimate, 1944	<u>250,000</u>
Decrease (including decrease of \$3,050 travel funds returned to surplus)	<u>-26,000</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Eradicating cattle ticks	\$292,277:	\$272,950 :	\$250,000 :	-\$22,950 (
Covered into Treasury in accordance with Public Law 674	- -:	3,050 :	- - :	-3,050
Unobligated balance	7,352:	- - :	- - :	- -
Total estimate or appropriation	300,629:	276,000 :	250,000 :	-26,000

DECREASE

The decrease of \$26,000 in this item for 1944 consists of \$3,050 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$22,950 in the item for eradicating cattle ticks which will be met by reducing the number of temporary agents assigned to this work. The curtailment in the work will be chiefly in Florida, Texas, and Puerto Rico.

WORK UNDER THIS APPROPRIATION

Objective: To free the continental United States, Puerto Rico, and the Virgin Islands of the serious disease splenetic or tick fever by eradicating the cattle fever tick which is the only natural carrier of this disease.

The Problem and its Significance: The chief economic importance of the cattle fever tick lies in the fact that this parasite is the only natural carrier of the disease splenetic or tick fever of cattle, and that so long as this disease is endemic in any region it discourages or prevents the development of the beef and dairy industries and particularly inhibits the improvement of the native stock by preventing the introduction of improved breeding cattle. It is increasingly important that the freed areas be protected from reinfestation by eradicating the tick in the few remaining quarantined sections and by controlling livestock movements from tick areas.

General Plan: The plan is to establish and direct effective eradication methods, to assist cooperating agencies in conducting the work of eradication, and to prevent reinfestation in tick-free areas by the proper treatment and control of livestock movements from tick-infested areas. Systematic dipping of cattle in an arsenical solution is conducted cooperatively under provisions of state and territorial laws.

Examples of Progress and Current Program: At the present time, the principal activities are in Florida, Texas, and Puerto Rico, while control activities and check inspections are being continued in Alabama, Arkansas, California, Louisiana and Mississippi. In Florida, Hendry and Collier Counties remain under quarantine. In Texas principal activities are in a narrow strip of quarantined area extending through parts of 8 counties along the lower Rio Grande. This area is being maintained as a buffer in an effort to control the introduction of ticks on smuggled or straying animals from Mexico. In Puerto Rico the work is in the final or clean-up stage. In California, after that State had been tick-free for several years, fever tick infestation was again introduced from adjacent infested areas in Mexico. This reinfestation is confined to a small section in the southwest corner of San Diego County and no extensive spread from that area is anticipated. In the States of Alabama, Arkansas, Louisiana and Mississippi, the work consists of re-inspecting wherever tick infestation is suspected or reported and taking necessary control measures.

In this work, the cooperating agencies during the last fiscal year supervised 9,283,137 inspections or dippings of cattle, 624,679 inspections or dippings of horses and mules, and 401,693 inspections or dippings of sheep and goats.

(f) HOG CHOLERA CONTROL

Appropriation Act, 1943	\$102,000
Budget estimate, 1944	<u>100,580</u>
Decrease (travel funds returned to surplus) .	<u>-1,420</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
Hog cholera control	\$110,077	\$100,580	\$100,580	-
Covered into Treasury in accordance with Public Law 674	-	1,420	-	-\$1,420
Unobligated balance	3,420	-	-	-
Total estimate or appropriation	113,497	102,000	100,580	-1,420

WORK UNDER THIS APPROPRIATION

Objective: To assist swine growers in preventing outbreaks of hog cholera and in controlling this highly infectious and fatal disease of swine when outbreaks occur.

The Problem and its Significance: Hog cholera is the most serious disease of swine and is found in all sections of the country. It takes the highest death toll of all hog diseases and where uncontrolled is capable of ruining the swine industry. The problem is to secure the widest application of effective preventive and control measures and thereby reduce losses from the disease; to demonstrate the importance of sanitary surroundings in preventing and controlling swine diseases; and to prevent the dissemination of swine diseases by controlling the movement of diseased swine or the exposure of healthy swine to an infected premise.

General Plan: Specially trained veterinarians are stationed in the principal swine growing sections of the country to consult with and assist veterinary practitioners and others in diagnosing swine diseases, and through meetings and by personal contact to advise and demonstrate to farmers and others the approved methods of preventing and controlling swine diseases.

Examples of Progress and Current Program: During the fiscal year ending June 30, 1942, through their visits to farms and attendance at meetings, these veterinarians had opportunity for 59,675 farm inspections and consultations relating to swine diseases with farmers, veterinarians, state officials, and others. Educational work was continued by these veterinarians, who attended 279 meetings at which there was an attendance of 25,626 persons. During the year 4,818 outbreaks of cholera were reported to these veterinarians. These measures have greatly reduced losses from hog cholera and have prevented widespread outbreaks of this disease.

(g) INSPECTION AND QUARANTINE

Appropriation Act, 1943	\$666,000
Budget estimate, 1944	<u>661,350</u>
Decrease (including decrease of \$4,525 travel funds returned to surplus)	<u>-4,650</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Scabies eradication	\$106,825	\$111,900	\$111,900	- - -
2. Control over interstate shipment of livestock for the purpose of preventing the spread of communicable diseases	281,189	301,700	301,575	-\$125 (1)
3. Enforcement of the 28-hour law	27,253	25,795	25,795	- -
4. Determination by inspectors in the field of the existence of diseases	64,718	53,430	53,430	- -
5. Inspection and quarantine of import animals	96,918	104,660	104,660	- -
6. Supervision over the importation of hides and other animal by-products, forage, etc.	57,923	61,390	61,390	- -
7. Inspection and testing of animals for export	3,193	2,600	2,600	- -
Transfer from "Meat Inspection, Bureau of Animal Industry	-4,000	- -	- -	- -
Covered into Treasury in accordance with Public Law 674	- -	4,525	- -	-4,525
Unobligated balance	1,908	- -	- -	- -
Total estimate or appropriation	635,927	666,000	661,350	-4,650

DECREASE

The decrease of \$4,650 for 1944 consists of \$4,525 decrease in travel funds (returned to surplus in 1943) and:

(1) A reduction of \$125 due to the discontinuance of publication pursuant to Office of War Information Regulation No. 3.

WORK UNDER THIS APPROPRIATION

Objective: The eradication of scabies and dourine in cooperation with the various states; the investigation of reported outbreaks of diseases among livestock to determine if they are communicable and, if so, assisting local authorities in their control and eradication; the application of tests in the field and in the laboratory for diagnostic purposes; the control over interstate movements of livestock as a means of preventing the dissemination of infections, which includes inspection at the principal market centers; the administration of the 28-hour law to prevent cruelty to animals in interstate transportation; the inspection and testing of livestock intended for export, to determine their freedom from disease, and the inspection of fittings and accommodations on vessels on which they are to be transported; the inspection and quarantine of livestock offered for importation; control over import animal byproducts, hay and straw, etc., to prevent the introduction or dissemination of communicable livestock diseases; and the administration, jointly with the Treasury Department, of Section 306 of the Tariff Act of 1930, prohibiting the importation of domestic ruminants or swine, or chilled or frozen fresh meats derived therefrom, from countries where foot-and-mouth disease or rinderpest exists.

The Problem and its Significance: Scabies and the other diseases covered by this item are readily disseminated and their control or eradication is important for the protection of the livestock industry.

The discovery at public stockyards of shipments of livestock affected with communicable diseases is necessary in order to prevent the spread of disease and to trace infection back to its source. It is also necessary to insure the safe and humane handling of livestock by railroads while in the course of interstate transportation.

It is important to safeguard the livestock industry against serious losses by preventing the introduction of destructive communicable diseases from other countries through the importation of livestock or through the medium of infected or contaminated animal byproducts, hay, straw, etc.

In order to protect and promote foreign trade it is necessary to prevent the exportation of any animals that have been exposed to any communicable disease and to provide for their safe transportation.

General Plan: Disease eradication work is carried on in cooperation with the states involved. In public stockyards work an inspection force is maintained at principal market centers to prevent the dissemination of livestock diseases by detecting, segregating and supervising the appropriate treatment or other disposal of animals affected with or exposed to contagious, infectious or communicable disease, and supervising the treatment and disinfection of all cars, trucks and other conveyances used in the transportation of infected animals, and all pens, chutes and alleys in which such animals are handled. Waybills and other records are examined to determine whether there have been any violations of the 28-hour law. Pens are also examined

as to suitability for feeding, watering, and resting. In the import work under this item inspectors are assigned to stations along the international boundaries and on the seacoast to inspect animals, and when necessary to place them in quarantine, and to inspect animal byproducts, hay, straw, etc. In export work, animals are inspected and tested at ports and in the various districts of origin throughout the country.

Examples of Progress and Current Program:

Scabies eradication: During the fiscal year 1942, inspections and supervised dippings of sheep in the field totaled 13,176,458 and 1,149,562, respectively. Infection was found in 1,763 flocks, an increase of approximately 16 percent over the previous year. All but a comparatively few of the infected flocks were found in the Midwestern States and western Louisiana. Cooperative campaigns are in progress in eight states. A few cases of re-infestation in the range areas of the West, where it appeared the disease had been completely eradicated, were promptly dealt with. A total of 1,679,721 inspections of cattle were made in the field and 86,848 dippings were supervised. The number of cattle in infected herds was 11,741, about 20 percent less than the number reported the previous year. However, reintroduction of infection which occurs from time to time indicates that continued watchfulness will be essential so long as any infection remains in the country.

Control over interstate shipment of livestock for the purpose of preventing the spread of communicable disease: The work in connection with the inspection of livestock moving interstate does not vary greatly from year to year. It is most important that no affected animal be permitted to pass through a public stockyard and establish a new center of infection. Thus it is imperative that all animals in yards under Bureau supervision be thoroughly inspected.

The progressive increase in the transportation of livestock by motor truck rather than by railroad continued through the past fiscal year. In 1942 there were 46 cities where stations were maintained for public stockyard inspection. A total of 71,553,988 animals were inspected including 20,227,733 cattle, 21,958,280 sheep and 29,367,975 swine. A total of 479,967 animals were dipped or immunized including 1,688 cattle, 219,875 sheep, and 258,404 swine. Infectious cars received numbered 407 and cars cleaned and disinfected 3,381. These figures do not fairly indicate the amount of work involved for the reason that more work is required in the inspection of truck shipments than in the inspection of shipments received by rail.

Enforcement of the 28-hour law: The volume of work under the enforcement of the 28-hour law is controlled by the number of alleged violations brought to the attention of the Bureau, shown for recent years in the following table:

	<u>1940</u>	<u>1941</u>	<u>1942</u>
Enforcement of the 28-hour law:			
Violations reported to bureau	201	244	757
Violations referred to Solicitor	100	182	504
Disposition of cases by other agencies:			
Violations investigated by the Bureau	201	244	757
Violations referred to Solicitor of Department	100	182	504
Violations referred to Department of Justice	66	217	473
Cases terminated during year	220	121	299
Cases pending end of year	58	154	328
Number of convictions	150	117	280
Amount of penalties	\$15,300	\$11,875	\$29,750

Determination by inspectors in the field of the existence of disease:

Under this project the most pressing problem was the continuation of our efforts in cooperation with state authorities to determine the extent of existence of dourine of horses in Arizona, southern California and Nevada, and to eradicate it where found. This work consists of drawing blood samples from all horses in the areas involved and forwarding the sera to Washington for complement-fixation test in the Bureau's pathological laboratory. Animals found by the test to be affected with dourine are destroyed. The heaviest infection has been found to exist in south-central Arizona, in an area which includes several Indian reservations, where the work is done in cooperation with the Office of Indian Affairs. Because the majority of the horses in that area are wild range animals, and because of topographical and climatic conditions, eradication work is unusually difficult and expensive. During the fiscal year 1942, 17,574 horses were tested on Indian reservations in Arizona revealing 488 reactors. In the remainder of the areas involved, tests of 52,506 horses revealed 33 as positive reactors. Dourine exists also in the same general region in the Republic of Mexico and the Bureau cooperated with Mexican authorities in testing almost 7,000 horses.

No serious outbreak of anthrax or other communicable disease handled under this project occurred during the year. The usual assistance by Bureau employees in administering preventive treatment to Indian-owned cattle on reservations where anthrax is known to exist was continued. All reports of cases suspected of being foot-and-mouth disease were promptly and carefully investigated.

Inspection and quarantine of import animals: In the fiscal year 1942, inspections at the various ports totaled 844,860 a slight increase over the previous year. Of these, 24,298 animals were refused entry on account of disease and 86 were detained in quarantine for further observation and testing to determine their freedom from infection. The number and kind of animals inspected for importation were as follows:

Ports of Entry	Cattle	Swine	Sheep	Goats	Horses and mules	Asses	Other Animals	Total
Ocean ports.....	310	6	159	-	223	3	38	739
Canadian border ports	304,753	11,418	5,470	95	5,925	3	9	327,673
Mexican border ports.	511,863	1,941	260	14	2,002	67	301	516,448
Total.....	816,926	13,365	5,889	109	8,150	73	348	844,860

Supervision over the importation of hides and other animal byproducts, forage, etc.: Supervision was exercised over the entry and the transportation to and handling at destination establishments of over 10,000,000 hides and skins, as well as other animal byproducts imported from countries where foot-and-mouth disease or rinderpest is known to exist. A total of 1,976 railway cars and large numbers of trucks and ship compartments used in the transportation of restricted import products were disinfected, as were premises involved in the handling of such products.

Inspection and testing of animals for export: During the past fiscal year 9,786 animals were inspected prior to their exportation in compliance with the regulations of the Department and in order to meet the requirements of receiving countries. These included 4,674 cattle, 2,700 sheep, 334 goats, 423 swine, 1,610 equines and 45 other animals.

(h) MEAT INSPECTION

Appropriation Act, 1943	\$6,147,000
Second Supplemental National Defense Appropriation Act, 1943	680,000
Total available, 1943	6,827,000
Budget estimate, 1944	7,134,079
Increase (including decrease of \$4,121 travel funds returned to surplus)	<u>+307,079</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Meat inspection operations at packing plants under the Federal meat inspection service	\$5,715,114	\$6,667,824	\$6,979,024	+\$311,200(1)
2. Determination of adulterations and other objectionable conditions in meat and meat food products by laboratory analyses	81,581	92,900	92,900	- -
3. Inspection of imported meat and meat food products	26,831	34,835	34,835	- -
4. Chemical, pathological, and zoological investigations relating to meat inspection	25,597	27,320	27,320	- -
Transfer to "Inspection and Quarantine," Bureau of Animal Industry	+4,000	- -	- -	- -
Covered into Treasury in accordance with Public Law 674	- -	4,121	- -	-\$4,121
Unobligated balance	31,950	- -	- -	- -
Total estimate or appropriation .	5,885,073	6,827,000	7,134,079	+307,079

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INCREASE OR DECREASE

The increase of \$307,072 in this item for 1944 consists of \$4,121 decrease in travel funds (returned to surplus in 1943) and:

(1) An increase of \$311,200 under the project "Meat inspection operations at packing plants under the Federal meat inspection service," to provide on a full year basis in 1944 for additional meat inspection resulting from the Act of June 10, 1942 extending inspection services to intrastate commerce. A supplemental appropriation provided \$680,000 for this additional work load for eight months of 1943.

Objective: To meet increased demands upon the Federal meat inspection service at slaughtering and meat processing establishments engaged in interstate commerce, as a result of the war situation, including operations under the provisions of the Act of June 10, 1942 (56 Stat. 351), authorizing the Secretary of Agriculture to extend Federal meat inspection during the present war emergency to meat packing establishments engaged in intrastate commerce in order to facilitate the purchase of meat and meat food products by Federal agencies. The Second Supplemental National Defense Appropriation Act, 1943, appropriated \$680,000 for this purpose on a basis of approximately 8 months of the fiscal year 1943. The increase of \$311,200 is the amount needed to carry on this work on a 12-months' basis in the fiscal year 1944.

The Problem and its Significance: The Federal Meat Inspection Act, with certain exceptions covering farmers, retail butchers, and retail dealers, prohibits the interstate movement of meats and meat food products unless they are prepared at establishments meeting sanitary and construction requirements and operating under inspection service provided for in the Act. Specifications for the purchase of meats and meat food products under the lend-lease program and by the Army, Navy, and other Government agencies, require that the product be prepared at an establishment operating under Federal meat inspection.

The Department estimates that at regularly inspected establishments hog slaughtering will be increased about 14,000,000 during this fiscal year and cattle about 1,000,000. The estimates on sheep and calves show small increases. Increased slaughter requires increased inspections, followed with correspondingly increased inspections in the processing departments. At inspected establishments long daily hours of inspection are being initiated more and more to the extent of working two or three daily shifts, in order to handle the increased slaughtering and processing with the existing plants and equipment.

The following table is indicative of the amount of work conducted under this appropriation for the fiscal years 1937 to 1942, inclusive:

Slaughter by Species and Total Processing at Federally Inspected Establishments

Year:	Cattle	Calves	Sheep and Lambs	Swine	Total	Total processing (pounds)
1937:	10,900,631:	6,413,820:	17,656,798:	36,226,309:	71,197,558:	7,740,872,352
1938:	9,974,274:	5,841,174:	17,676,408:	32,453,905:	65,945,761:	7,505,444,990
1939:	9,541,238:	5,383,505:	17,504,256:	38,656,537:	71,085,536:	8,440,446,161
1940:	9,560,329:	5,223,172:	17,262,684:	46,673,925:	78,720,110:	9,690,165,254
1941:	10,126,861:	5,393,566:	17,811,612:	48,710,059:	82,042,098:	10,514,837,866
1942:	11,761,746:	5,544,745:	18,547,305:	50,133,871:	85,987,667:	12,039,492,563

Additional funds in the amount of \$375,000 were made available for the last 8 months of the fiscal year 1942 to handle the increased volume due primarily to lend-lease activities and these funds were continued on a full-year basis in the regular Appropriation Act for the fiscal year 1943. However, with the entrance of the United States into the war the volume of work at inspected establishments has increased to the point where the additional funds are far from adequate to conduct the work.

The Act of June 10, 1942 permits Federal meat inspection to be inaugurated at plants meeting the requirements but which do only an intrastate business in order that such plants may qualify to bid on Federal contracts. Examinations and inspections of products of intrastate packers will be made in line with the inspection now given to interstate packers.

General Plan: Present Federal meat inspection activities will be expanded and extended, but there will be no material change in the present plan of work. It is expected that the principal increase in work will be in connection with the slaughtering of hogs, but the slaughtering of all species of food animals will be increased. The processing of meat, principally pork, will also be correspondingly increased.

Under the new law slaughtering and meat processing under Federal meat inspection will be expanded by making available plants and facilities not heretofore in a position to participate in the preparation of meats for Government agencies due to lack of Federal inspection.

CHANGE IN LANGUAGE

The estimates include a proposed change in the language of this item, as follows (new language underscored, deleted matter enclosed with brackets):

Meat inspection: For [expenses in] carrying out the provisions of [the Meat Inspection Act of June 30, 1906, as amended by the Act of March 4, 1907, as extended to equine meat by the Act of July 24, 1919 (21 U. S. C. 71-96), as authorized by section 2 (a) of the Act of June 26, 1934 (31 U. S. C. 725a), and as further amended by the Act of June 29, 1938 (21 U. S. C. 91)] laws relating to Federal inspection of meat and meat food products, including the purchase of printed tags, labels, stamps, and certificates without regard to existing laws applicable to public printing, [\$6,147,000] \$7,134,079.

This change, which eliminates detailed references to statutes relating to meat inspection and substitutes a general statement referring to such laws, is proposed in the interest of simplification of the language of the item. No change in authority is involved.

WORK UNDER THIS APPROPRIATION

Objective: Federal meat inspection has for its purpose the prevention, through the enforcement of the Meat Inspection Acts, of the use in interstate or foreign commerce of meat and meat food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food. During the present war emergency it has been extended to meat packing establishments engaged in intrastate commerce to facilitate the purchase of meat and meat products by Federal agencies.

The Problem and its Significance: For efficient results, each animal must be inspected before a slaughter and each carcass, including organs and parts thereof, must be carefully examined at the time of slaughter. Approximately 7.57 percent of all animals slaughtered are affected with some degree of abnormality, which is seldom obvious except on close scrutiny. Accordingly, the constant presence of inspectors and their careful examination in every detail are required during slaughtering operations.

Meat and meat food products are perishable. Accordingly, reinspections requiring the regular presence and careful observation of inspectors are necessary throughout the stages of processing, preparing, and packing of such products. The ingredients, spices and other substances added to meat and to meat products must be carefully scrutinized as to their wholesomeness and proper use. Condemned animals, carcasses and parts, and meat food products must be destroyed under strict supervision and the passed articles must be truthfully and informatively labeled. Observations and investigations of the activities of common carriers of meat and meat products are necessary from time to time to see that only product of appropriate eligibility is shipped interstate.

Under the Import Meat Act and the Meat Inspection Acts, meat and meat food products from countries having a national system of inspection which, as determined by the Secretary of Agriculture, is the substantial equivalent of the system maintained in the United States may be offered for entry. However each consignment is carefully inspected to see that only meat and meat food products are accepted for importation which have been properly certified from abroad; and that they are sound, healthful, wholesome, and otherwise fit for food, and truthfully labeled.

A large variety of specimens are submitted to the various Bureau laboratories each year for chemical, pathological and zoological investigations.

General Plan: The principal meat inspection operations at meat packing establishments include ante-mortem and post-mortem inspections of cattle, sheep, swine, goats, and, to a limited degree, of horses; reinspection of meat and meat products during processing, preparation, and packing; and the supervision of marking and branding of products to insure truthful labeling. In addition, the service includes inspection under the Import Meat Act and Meat Inspection Acts of imported meat and meat food products; laboratory examinations as assurance against adulterations or similarly objectionable conditions, and determination of the character and importance of abnormal

conditions in food animals encountered in ante-mortem and post-mortem inspections and subsequent inspections of meat and meat food products derived therefrom.

Examples of Progress and Current Program:

Meat inspection operations at packing plants under the Federal Meat Inspection Service: The work of Federal meat inspection is essentially regulatory and is not subject to material variations in procedure. Its prime purpose is to protect consumers from harmful and unfit meats and meat food products resulting principally from disease and other dangerous conditions in animals slaughtered and in spoilage of meat and meat food products derived from carcasses and parts of such animals.

While Federal meat inspection under normal conditions is fairly constant as to volume and costs, it is reacting to the military and civilian need for greatly increased supplies of meat and meat food products. This has resulted in (1) more intensive utilization of existing facilities in inspected establishments with more frequent need of repair and replacement, (2) enlargement of departments and increase in facilities in existing departments, and (3) an increase in the number of establishments that have come under Federal meat inspection. Assistance to the meat packing industry in meeting these needs in a way that would assure a proper standard of meat hygiene and at the same time husband critical materials such as iron, steel, copper, cork, and the like, has added materially to the responsibility of the meat inspection service.

Animals Inspected Ante-mortem and Post-mortem

iscal Year	Cattle	Calves	Sheep & lambs	Goats	Swine	Horses	Total
1940	: 9,560,329	: 5,223,172	: 17,262,684	: 3,061	: 46,693,925	: 28,178	: 78,751,349
1941	: 10,126,861	: 5,393,566	: 17,811,612	: 5,452	: 48,710,059	: 14,641	: 82,062,191
1942	: 11,761,746	: 5,544,745	: 18,547,305	: 9,498	: 50,133,871	: 30,787	: 86,027,952

Meats and Meat Food Products Prepared and Processed Under Supervision

1940 - 9,690,165,254
1941 - 10,514,837,866
1942 - 12,039,492,563

These figures represent "inspection pounds" as some of the products may have been inspected and recorded more than once due to having been subjected to more than one processing treatment, such as curing first and then canning.

Inspection for Other Government Agencies

1940 - 145,235,616
1941 - 425,565,970
1942 - 391,947,092

Inspection of such products to determine their compliance with specifications is generally reimbursed. However, such specifications usually require certain processing or treatment in addition to that necessary to prepare the product for the trade, and this increases accordingly meat inspection work for which no reimbursement can be claimed. The reduction in 1942 is due to the fact that the larger proportion of inspections for specifications of the Federal Surplus Commodities Corporation were made by the Agricultural Marketing Administration, our inspections for the Corporation being reduced from 256,000,000 pounds in 1941 to 13,000,000 in 1942.

Determination of adulterations and other objectionable conditions in meats and meat food products by laboratory analysis:

Number of samples examined: 1940-- 33,894
1941 - 28,972
1942 - 30,310

Inspection of Imported Meats and Meat Food Products:

1940 - 116,436,662
1941 - 106,954,815
1942 - 190,416,650

Chemical, pathological, and zoological investigations relating to meat inspection: For a number of years, chemical and biological studies have been conducted with meats and meat products with particular relation to their composition and nutritive properties as affected by methods of processing, manufacture, curing and storage. The primary purpose of these studies has been to furnish information which would be of aid in the enforcement of the Meat Inspection Act, but some of the results obtained have found a wider application.

During the past fiscal year, studies concerning the nutritive properties of seven kinds of animal and vegetable fats have been completed. The results show rather wide differences between the digestibility of certain fats, and smaller differences between their growth-promoting values. The digestibility of several fats intended for use in the tropics by our armed forces has been determined. These products were found to be somewhat less digestible than butter. Similar tests with other samples of fats with high melting points are in progress. These tests involve the question of raising the melting points of fats intended for use in the tropics and other overseas points.

Special studies of arthritis in swine have continued. A large number of affected joint specimens have been studied bacteriologically. The findings indicate that more than 75 percent of these cases are due to the swine erysipelas infection.

An unusually large number of cases of a dropsical condition, more commonly referred to as anasarca, were observed in cattle by inspectors in slaughtering establishments. Over a 5-months' period, 124 such cases were reported and 118 were condemned. Laboratory studies made of a number of these cases

revealed an extensive edema or waterlogged condition of the muscle tissue with a consequent degeneration that rendered the carcasses unwholesome and unfit for food. The history of these cases and the other available evidence indicates that the edematous condition is of dietary origin or caused by vitamin A deficiency.

Tests on the survival of tapeworm cysts in a beef carcass showed that when the whole carcass was refrigerated at 15° F. for 4 days, about 60 percent of the cysts examined were still alive; after 7 days about 35 percent of the parasites were still alive; and after 9 days no live parasites were recovered. Further work is in progress to ascertain definitely the period that is adequate to destroy the vitality of tapeworm cysts in beef maintained at 15° F.

A large number of tissue specimens, representing a variety of diseases and disease conditions, were received for diagnosis from meat-producing animals slaughtered at establishments under Federal meat inspection. Diagnoses in these cases made possible the proper disposition of retained carcasses. Through these diagnoses, efficiency of the inspection force is increased.

(i) VIRUS-SERUM-TOXIN ACT

Appropriation Act, 1943	\$223,718
Budget estimate, 1944	223,148
Decrease (travel funds returned to surplus) ...	<u>-570</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
Control of manufacture, importa- tion and shipment of viruses, serums, toxins, etc.	\$220,302	\$223,148	\$223,148	- -
Covered into Treasury in accord- ance with Public Law 674	- -	570	- -	-\$570
Unobligated balance	625	- -	- -	- -
Total estimate or appropria- tion	220,927	223,718	223,148	-570

WORK UNDER THIS APPROPRIATION

Objective: To insure that all veterinary biologics produced by licensees are, in fact, not worthless, contaminated, dangerous, or harmful, and to prevent, insofar as possible, the interstate movement or importation of any veterinary biologic product, organism, or vector that is worthless, contaminated, dangerous, or harmful.

The Problem and its Significance: Biological products that are not properly prepared and tested may be worthless, contaminated, dangerous, or harmful to animals treated therewith. They may either fail to prevent or control an outbreak of disease and may even be the means of spreading disease. A license issued by the Secretary should carry with it reasonable assurance to the livestock producer that the products when properly used will afford protection and not be harmful to his animals. A biologic that is contaminated or otherwise improperly prepared, not only may endanger the herd that is treated, but may prove disastrous to other herds in the community through failure of the product in some respect.

General Plan: This entails the detailing of sufficient inspectors to the establishments producing anti-hog-cholera serum and hog-cholera virus so that all operations connected with the production and testing of these products are carried out under direct supervision. Inspection of plants producing biological products other than anti-hog-cholera serum and hog-cholera virus is made periodically or upon instructions for special reasons.

Examples of Progress and Current Program: The increase in estimated production for 1943 and 1944, as reflected in the following table, is occasioned by anticipated increased demands to safeguard the livestock population during the war emergency. Experience has demonstrated that any increase in value of an demand for livestock or their products also increases the demand for biologics for use in combating animal diseases. Licensees are enlarging their production facilities whenever practicable.

	: Actual	: Estimated
	: 1942	: 1943 and 1944
(a) Establishments producing anti-hog-	:	:
cholera serum and hog-cholera	:	:
virus	:42	:42
Production:	:	:
Serum (cc)	:1,387,785,181	:1,665,332,217
Virus (cc) :	:	:
Simultaneous	: 104,815,575	: 125,778,690
Hyperimmunizing	: 277,999,251	: 333,599,101
Inoculating	: 1,216,525	: 1,459,830
Animal inspections	: 4,077,250	: 4,892,700
Tests supervised	: 16,997	: 20,936
(b) Establishments producing other	:	:
biologics	:38	:40
Production:	:	:
Doses	: 189,521,369	: 226,425,642
Units (Tetanus antitoxin and	:	:
other products)	: 734,408,250	: 881,349,900
(c) Products destroyed (cc)	: 26,243,445	: 31,492,134
Products destroyed (doses)	: 3,749,063	: 4,354,763
(d) Export certificates issued	: 626	: 751
	:	:

(j) MARKETING AGREEMENTS WITH
RESPECT TO HOG-CHOLERA VIRUS AND SERUM

Appropriation Act, 1943	\$30,708 (a)
Budget estimate, 1944	30,689 (a)
Decrease (travel funds returned to surplus)	<u>-19</u>

(a) Transferred from the unobligated balance of the appropriation provided by section 12(a), Title I, of the Agricultural Adjustment Act of May 12, 1933.

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
Marketing agreements with respect to hog-cholera virus and serum	\$30,000	\$30,689	\$30,689	- -
Covered into Treasury in accordance with Public Law 674	- -	19	- -	-\$19
Unobligated balance	- -	- -	- -	- -
Total estimate or appropriation	30,000	30,708	30,689	-19

WORK UNDER THIS APPROPRIATION

Objective: To insure that the control agency and handlers of anti-hog-cholera virus observe the provisions of the marketing agreement and order.

The Problem and its Significance: The Serum and Virus Law of August 24, 1935, and Marketing Agreement of December 7, 1936, stress the economic importance of producers and other handlers maintaining an adequate supply of serum and virus at all times, and aim to prevent undue and excessive fluctuations of prices, unfair methods of competition, and unfair trade practices.

General Plan: The work relates mainly to reviewing acts of the control agency, attendance at meetings, and the assembling of economic data relating to the production, sales, and prices of anti-hog-cholera serum and hog-cholera virus. Proposed amendments to the agreement and order have entailed conferences and public hearing for the purpose of receiving testimony and affording all interested parties the opportunity to file briefs. The marketing agreement is enforced by a control agency selected by the Secretary and handlers, whose acts are subject to review by the Secretary and his representatives.

At the close of the fiscal year 1942, there were 212 handlers of anti-hog cholera serum and virus operating under the marketing agreement, an increase of 24 over the previous fiscal year.

(k) ERADICATION OF FOOT-AND-MOUTH
AND OTHER CONTAGIOUS DISEASES OF ANIMALS

This item continues the availability of \$305,000 of the unexpended balance of the appropriation of \$3,500,000 made in 1924 to be used in case of an emergency arising from an outbreak of foot-and-mouth or other contagious diseases of animals. It provides also that \$5,000 of this balance may, if needed, be used for the control of European fowl pest and similar diseases in poultry. No expenditures are contemplated during the fiscal year 1943 unless an emergency arises, but it is essential that funds be available at all times to insure immediate protection of the American livestock industry should outbreaks occur. This is particularly important under present world conditions when most countries are at war. In many of them there has been a complete breakdown of livestock sanitary requirements.

SUPPLEMENTAL FUNDS

(not otherwise explained)

Direct Allotments

Project	:	Obligations	:	Estimated obligations,	:	Estimated obligations
	:	1942	:	1943	:	1944
<u>Special Research Fund, Department of</u>	:		:		:	
<u>Agriculture:</u>	:		:		:	
Special research projects	:	\$43,600	:	\$37,260	:	\$37,260
Special research laboratories in	:		:		:	
major agricultural regions	:	266,330	:	275,834	:	280,834
Total, Special Research Fund ...	:	310,130	:	313,094	:	318,094
<u>Working Fund, Agriculture, General</u>	:		:		:	
(Emergency Management): Investiga-	:		:		:	
tions in the bulk and weight of the	:		:		:	
ration for army horses	:	275	:	4,725	:	- -
TOTAL, SUPPLEMENTAL FUNDS	:		:		:	
(Direct allotments)	:	310,405	:	317,819	:	318,094

PASSENGER-CARRYING VEHICLES

The amount included for the fiscal year 1944 (\$177,600) will permit the Bureau to replace 185 old vehicles at an average cost of \$960, including freight when exchange allowances are taken into account. This is about 24 percent of the Bureau's cars. Of the 778 Bureau passenger-carrying vehicles now in operation, nearly 95 percent are used in inspectional work on farms in rural districts, and many of them have mileage of 18,000 and upward a year. It has been the Bureau's

experience that cars assigned to rural inspectional work receive such rough use on secondary and county roads and lanes leading to farms that they must be replaced on an average of about every three years, in order to keep mileage charges at the lowest possible point and to prevent frequent interruptions to the work which occur due to breakdowns when badly worn equipment is kept in service. However, under present conditions it is realized that it is imperative to use cars as long as possible, even though an earlier replacement would be more economical. Every means possible is being used to extend the life of all cars, and it is believed it may be possible to get an average of four years' service from each. All the cars to be replaced have reached the point where they can no longer be operated economically, the average mileage being over 40,000 and in individual cases running as high as 60,000.

The Bureau is unable to carry on economically and efficiently its varied activities in the field by the use of public transportation. Therefore, when government-owned cars are not available, it is necessary to authorize employees to operate their privately-owned cars on a mileage basis. The Bureau has found that the use of government-owned passenger-carrying vehicles for transporting its employees is considerably less expensive than when reimbursement is made to employees for the use of their own cars, and that they can be operated in almost every section of the country for slightly over 3 cents a mile. This estimate is based on purchase price and operation charges, less amounts received when old cars are disposed of.

BUREAU OF DAIRY INDUSTRY

(a) SALARIES AND EXPENSES

Appropriation Act, 1943	\$764,757
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Office of Adminis- trator, Agricultural Research Administra- tion"	-5,000
"Salaries and expenses, Library"	<u>-5,140</u>
 Total available, 1943	756,617
Budget estimate, 1944	<u>755,720</u>
Decrease (including decrease of \$588 in travel funds returned to surplus)	<u><u>-897</u></u>

PROJECT STATEMENT

Projects	: : 1942	: : 1943 :(estimated):	: : 1944 :(estimated):	: : Increase or : decrease
1. Investigations of milk and butterfat production of dairy cows	: : :\$480,295	: : :\$489,202	: : :\$488,893	: : :-\$309 (1)
2. Market-milk investigations	: 27,849	: 31,744	: 31,744	: --
3. Investigations of the utiliza- tion of milk in the manufacture: of milk products	: : : 140,020	: : : 153,287	: : : 153,287	: : : --
4. General administration and business service	: : : 74,816	: : : 81,796	: : : 81,796	: : : --
Covered into Treasury in accordance with Public Law 674	: : : --	: : : 588	: : : --	: : : -588
Unobligated balance	: 9,557	: --	: --	: --
 Total estimate 1944 and comparable: amounts 1942 and 1943	: : : 732,537	: : : 756,617	: : : 755,720	: : : -897

DECREASES

The decrease of \$897 in this item for 1944 consists of \$588 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$309 due to discontinuance of certain publications.

WORK UNDER THIS APPROPRIATION

Objective: To increase the milk and butterfat producing efficiency of the Nation's dairy cows; to improve the quality of products made from milk; to effect greater efficiency in manufacturing methods; to develop new milk products and provide for the more efficient utilization of milk byproducts; to investigate the sanitary production, transportation, processing, and distribution of market milk and cream.

The Problem and its Significance: There are about 26 million cows in the United States kept for milking purposes whose average butterfat production is only 181 pounds a year. Only one-third of these cows is actually returning a profit to their owners. Methods of selecting and breeding must be devised whereby 90 percent or more of the animals raised for dairy purposes will possess an inheritance for profitable production when properly fed and managed. This problem has particular significance at this time if the necessary quantities of milk are to be produced to supply military, civilian, and lend-lease needs.

The national dairy herd must be fed in a manner which will insure that the health of the animals will be maintained, that the milk and butterfat produced will contain a maximum of nutritive and health-giving properties. Research is being directed toward finding more economical methods of feeding for milk production, in order to demonstrate that, although some methods of feeding actually lower the production of good cows, at the same time they are more economical than the commonly accepted feeding practices because of their lower cost.

Quality control in the manufacture of dairy products is possible only through a knowledge of the bacteriological and chemical changes involved and the application of this knowledge to factory processes. This requires research to provide the basis for formulas and rules applicable to factory conditions. Defects in quality are usually the result of insufficient knowledge of the factors influencing flavor or texture and of the methods controlling these factors under commercial conditions.

General Plan: The work is organized and conducted under three research projects: Investigations of milk and butterfat production of dairy cows; market-milk investigations; and investigations of the utilization of milk in the manufacture of milk products. It is carried on through field and laboratory experiments in cooperation with state colleges, agricultural experiment stations, and extension services, other Government agencies, dairymen, and manufacturers of dairy products. Some phases of the work are conducted cooperatively in each state and in Hawaii and Puerto Rico. Breeding experiments are conducted to ascertain the comparative effects of different methods of breeding in fixing an inheritance for high and uniform levels of producing ability in dairy cows; to develop methods for judging at an early age the potential producing ability of heifers in order to avoid raising to maturity those heifer calves that should be discarded because of inferior milk-producing ability. Other phases of the production research are the effect of nutrients on growth, reproduction, health, and yield and composition of milk, and the effect of the application of breeding and feeding practices on the level and economy of production. Laboratory research which normally is devoted to studies of abstract and practical problems designed to improve the quality of dairy products, increase the efficiency of established practices, develop new products and processes and add to the general knowledge essential to proper handling of milk and its products, has been suspended for the duration of the

emergency and the work directed to projects having a direct relationship to the war effort.

Examples of Progress and Current Programs: The following are examples of recent accomplishments under this appropriation.

Investigations of milk and butterfat production of dairy cows:

Increased milk production through better breeding: The breeding experiments with dairy cattle being conducted are the only ones in existence that are proceeding according to a detailed plan and under carefully controlled environmental conditions. Data are being accumulated that will be of inestimable value to the entire livestock industry.

Breeding experiments with cattle are necessarily slow, but the experiments in which meritoriously proved sires are used for generation after generation, in an effort to fix an inheritance for high levels of production, are making definite progress. Criteria by which this progress may be measured are the relative producing ability of the cows by generations, the decreased frequency with which low-producing animals appear, and the transmitting ability for level of production of the bulls resulting from these matings. Bull calves from experimental herds are loaned to cooperating farmers for the purpose of obtaining a measure of their transmitting ability. The breeding experiments are proving a success in developing strains that possess a superior germ plasm for level of production and as a result cooperators have had the use of unusually good bulls. The records of dairy-herd-improvement associations and data from other sources indicate that for every bull the dairy farmer buys that improves the production of his herd, he also gets one that lowers the production. As a result he makes no progress in improving the hereditary ability of his cattle for better production. On the other hand, 85 percent of the bulls from these superior strains developed in the experimental herds have improved the production level in the herds of the cooperators. On the average, each daughter has produced 33 pounds more butterfat per year than her dam. There are now some 300 bulls from experimental herds in farmer-owned institutional herds.

While this germ plasm is increasing the actual production of milk, perhaps its greatest value is in the demonstration it is offering farmers of the value of good breeding in improving livestock. With the prevailing scarcity of labor on dairy farms, it is more important than ever before that each cow unit be a profitable producer.

Feeding for milk production: Experiments are being continued to determine methods for more economical and efficient feeding for milk production and for growing young stock; the more efficient management of pastures; determination of which feed crops are the most economical to produce, and of methods of curing roughages that will be most efficient in the preservation of their nutrients in the form that they can be best utilized by dairy cows. The results of these experiments are usually in such form that they can readily be used by dairy farmers. Insofar as possible the new projects taken up are those that it is believed will help solve the immediate problems of the dairyman. For example, a simple moisture tester has been perfected through the use of which farmers can make good silage without expensive preservatives and will, at the same time, prevent silo damage through excessive seepage of silage juice. This is especially important because of the high cost or unavailability of the commonly used preservatives.

Preliminary work shows that quick and thorough drainage of free juice from the silo will bring about the production of good silage in spite of a high moisture content. If this proves to be true, a big obstacle in the making of silage from hay crops will be removed and the more complete utilization of hay crops for dairy feed will be possible.

Most of the dried skim milk produced is being shipped abroad. Consequently, this product is unavailable for calf feeding. An experiment was conducted to ascertain if dried buttermilk and dried whey could be successfully substituted for dried skim milk in raising calves. The first experiment showed that calves of normal weight could be raised on these substitutes. Further work is required to successfully simplify the rations used.

Mastitis prevention and control: Because of the grave effects of mastitis (a chronic infection of the udder) on the national production of milk and butterfat, the activities relating to various phases of the relationship of conformation to producing ability in dairy cows have been devoted to a study of this disease, its effect on production, and its eradication and prevention. The Bureau of Animal Industry estimates the annual loss due to mastitis at 19 million dollars. Mastitis ranks next to Bang's disease in money loss and causes greater losses than tuberculosis and hog cholera. It is estimated that between 25 and 75 percent of the Nation's dairy cows are infected and that milk production from infected quarters is decreased from 6 to 22 percent, depending on the number of quarters infected. Numerous methods have been tried for its control but the disease appears to be on the increase.

The majority of the mastitis infections is due to Streptococcus agalactiae but in the Beltsville herd there has been an atypical infection due to Pseudomonas aeruginosa that has caused the loss of a number of valuable animals and the loss of one or more quarters of the udders in others. The milk of each quarter of the udder of each cow in the Beltsville herd is being studied to determine the extent and kind of bacterial infection that might cause mastitis. In the first 37 cows studied, 70 percent had one or more infected quarters and 37 percent of all quarters were infected.

These infected quarters are being treated by a relatively new form of treatment and the results being secured are most promising. Whether or not the bacteria that commonly cause mastitis can be eradicated from a herd and the herd kept free of the infection under practical conditions remains to be determined. At one of the Bureau's cooperating stations an attempt is being made to eradicate the infection by the use of the germicidal agents "Novoxil" and "Gramicidin", and some progress is reported. The experimental work appears to indicate that these agents do not injure the secretory tissue but their injection does result in a temporary reduction in milk flow. Another cooperating station is attempting to eradicate the infection by means of short-wave diathermy. It is hoped that through all of these experimental efforts a reliable, efficient, and economical treatment will evolve that will make it possible to control this disease.

Chemical composition and reaction of milk proteins: The value of the milk proteins in human nutrition depends upon the amounts of the various essential amino acids that these proteins contain. The efficiency of the utilization of feed proteins in the formation of milk proteins likewise depends upon the amino acid makeup of

these feed proteins. A knowledge, therefore, of the composition of proteins and the conditions that affect this composition is essential both in considering the nutritive value of milk and the utilization of feed proteins in milk production. The results of this work have also found application in the industrial utilization of proteins.

Chemical methods which have been developed have been applied to the study of the reactions of proteins when treated with concentrations of alkali. The work conducted has shed new light on the interpretation of work that has been done on the composition of proteins, and also suggests the mechanism of certain physiological reactions that occur in plant and animal metabolism. Further work, particularly with reference to the phosphoproteins, casein and vitellin, is in progress to ascertain the effect of the reaction of these proteins to alkali. The results are being found useful in the study of processes for making plastics and fibers from casein, and should be useful in controlling methods of processing foods so as not to destroy the nutritive value of the proteins in them, as well as in adding to the knowledge of the nutritive value of the milk proteins, and of the composition of the feed proteins required for their production.

Unidentified nutrients in milk: The existence of important still-unidentified nutrient(s) in milk and liver extracts was reported last year. This nutrient(s) has now been shown to occur in milk from both pasture-fed and barn-fed cows, in commercial skim-milk powders manufactured in various ways, in commercial casein, and in cottage, Cheddar, and Swiss cheese. Foods that may be used in place of milk and milk products will be tested. It not only is essential for normal growth (rats frequently grow twice as fast with it as without it, and plateau in growth at very subnormal weights without it), but animals with this factor in their diet utilize the energy in their feed so efficiently that they make better growth on the same amount of feed intake. This unidentified nutrient(s) is stable when heated at temperatures used in cooking. It resembles chemically the liver factor that is effective in the treatment of pernicious anemia in the human, but may not be identical with this factor. The physiological action of this unidentified nutrient, its occurrence in cow feeds, the effect of the feed of the cow on the amount of milk in milk, its occurrence in other human foods that may be used in place of milk and milk products, and its chemical and physical properties that may affect its stability in foods are now under investigation.

Vitamin A studies: A usable method for the chemical determination of the vitamin A potency of butter was worked out during the year in cooperation with six state experiment station laboratories. The method is being put into use by 25 or 30 state experiment stations in a survey of the vitamin A potency of market butters. This survey of the vitamin A potency of market butters was suggested by the National Research Council, and endorsed by the Department of Agriculture and the Association of Land-Grant Colleges because it would supply information of value in our national nutrition program and in the nutrition of our industrial and armed forces, particularly our air forces. The Bureau is continuing this work. At the time the National Research Council suggested a survey of the vitamin A potency of market

butters, it also suggested that studies be initiated of the normal variation in the vitamin A values of milk and butters as affected by feeding practices and that attention be directed to the improvement of these practices. Determination of the carotene content (vitamin A potency) of large numbers of samples of various grades of alfalfa, timothy, and clover hays, and of samples of corn silage prepared under various conditions have been made. The results of this work are published in the 1942 report of the Chief, Bureau of Dairy Industry, and are available as a guide in feeding to produce milk and butter that are rich in vitamin A. This work is also being continued.

Bulls may become useless because of a deficiency of vitamin A in their diet. They are often fed rations very poor in vitamin A. To what extent this may in practice lead to infertility is unknown. Work is continuing on the amount of vitamin A required in the diet to maintain their optimum usefulness. This may increase the extent of usefulness of bulls of desirable genetic qualities and lessen losses in milk production due to irregularities in the reproduction of the cow.

Daily samplings of corn silage with analyses of aliquots from monthly composites for a period of 5 years indicate a considerable variation in the carotene content of the silage made from year to year. Of 8 calvings of cows on rations consisting of grain and corn silage, there have been 2 calvings in which the calf was abnormal due to a deficiency of carotene in the silage fed to the mother. There have been a number of other difficulties with the animals on this ration; their general performance so far has not been satisfactory, and a careful investigation of the effect of the continuous use of this ration is in progress.

Relation of calcium to growth and milk production: Practically normal growth has been found to occur in young dairy stock with rations made up of grain and timothy hay, in which the timothy hay contained as little as 0.16 percent of calcium and no calcium supplement was fed. This was true even when the timothy hay consumption was limited to 2 kg. per day. A cow reared on such a diet, in which the hay consumption is limited, is now in milk in her second lactation. In her first lactation she produced 11,566 pounds of milk containing 395 pounds of fat although for the first 8 months of that lactation there was nearly 80 percent as much calcium in her milk as she was receiving in her feed. This did not affect the concentration of the calcium in her milk or produce any noticeable untoward effect. This experiment is being continued to determine the ultimate effect of such a diet.

Extensive experiments on the effect of various farm rations on growth, reproduction, production, health, and economic usefulness of dairy cattle, and on the quality of the milk produced, are continuing in addition to the work on the various problems noted above.

Increased milk production through herd improvement: The average milk and butterfat production of cows in dairy-herd-improvement associations is being steadily improved. On the average, since the testing work began in 1906 the production level has been raised approximately 750 pounds of milk and 30 pounds of butterfat each decade. At present, the production level of association cows is 8,225 pounds of milk and 335 pounds of butterfat per cow, which is higher than it has ever been before. Feed and production records obtained in dairy-herd-improvement associations are currently summarized and analyzed to provide information with which

dairymen may improve their herds through effective culling, by adopting improved feeding practices, and by carefully selecting breeding stock.

Through the proved-sire program the inheritance of association herds for high-producing efficiency is being further improved and the superior hereditary influence of association herds is being widely spread. Identification records for more than 1,000,000 animals have been established and production records for more than 600,000 cows have been recorded. Data are being accumulated on approximately 80,000 sires of which more than 10,000 have been proved, the records of which have been given wide distribution in order that dairymen may fully utilize the superior breeding stock found in association herds. During the past year the sixth annual list was published, which included the names and records of 1,850 proved sires.

In cooperation with the states, leadership is given the organization and operation of cooperative breeding associations. Through these associations outstanding proved sires are used extensively and their superior hereditary influence fully utilized. Four thousand three hundred sixty-four herds consisting of 43,251 cows are now provided with sire service through 295 cooperative associations. Seventy-two artificial breeding organizations are providing breeding service for approximately 4,300 herds consisting of more than 43,000 cows.

The dairy-herd-improvement association work in the states will continue to be sponsored and given leadership in cooperation with the state colleges. Data obtained in association herds will be summarized and analyzed in order to supply dairymen generally with information with which to continue improving the producing capacity of their herds.

Market-milk investigations:

Effect of pasteurization on goat's milk: Studies of the effect of pasteurization on the constituents of goat's milk were completed. This work has shown that, contrary to common belief, pasteurization does not impair the nutritive properties of the milk.

Digestibility of homogenized milk: Investigations dealing with the effect of homogenization on the curd tension, digestibility, and keeping qualities of milk were completed. These investigations developed practical methods of producing soft-curd homogenized milk. Digestion tests (*in vitro*) showed that the rate of proteolysis is very similar for boiled milk and homogenized milk but more rapid than in raw milk. However, after a period of 4 or 5 hours the total amount of proteolysis is about the same in all cases. This would indicate that boiled milk and homogenized milk are more readily but not more completely digested than raw milk. Homogenized milk forms smaller curds under artificial digestion, which is another indication that homogenized milk is more readily digested. Homogenized milk is more susceptible to the action of sunlight but less susceptible to metal from the standpoint of acquiring oxidized flavors.

Flavor-of-milk work: Investigation of the effect on the flavor of milk of such factors as feed, stage of lactation, season of the year, etc., were continued. More than 4,000 samples of milk were examined. The results show that the feeding of either molasses alfalfa silage or alfalfa silage without molasses did not

decrease the susceptibility of the milk produced to the development of an oxidized flavor. Soybean silage and corn silage were also fed but the results of these feeding experiments are not yet available. The development of spontaneous oxidized flavor is more prevalent in winter than in summer. This has led to the belief that dry feed is a contributing cause of the development of this flavor. Complete data from feeding experiments being conducted are not available, but preliminary data seem to indicate that prevailing theories are not well founded. Another phase of this work was to determine the effect of feeds on the ascorbic-acid (vitamin C) content of milk and its stability, and to determine whether there is any correlation between ascorbic acid and the development of oxidized flavor in milk. This work will be continued with other feeds and other management methods in view of the importance of the vitamin content of milk in a nutritional program.

Effect of cleaning solutions on metals: Investigations of the effect of various cleaning and sterilizing solutions on certain metals, which, because of the unavailability of stainless steel, will of necessity have to be used in the manufacture of dairy utensils and equipment, were conducted. Several substitute stainless steels in which the chromium was replaced in part by molybdenum gave the same corrosion resistance as did straight chrome stainless steel.

Effect of high-lead solder on milk: The War Production Board has limited the amount of tin in solder to not over 30 percent, which requires an increase of the lead content of the solder. This caused some apprehension in the dairy industry and among food-control officials regarding the possible lead contamination of milk from solder of the higher lead content. High- and low-lead solders in milk cans were tested under various conditions to determine the lead pickup by different dairy products. There was practically no increase in the lead pickup from the high-lead solder.

The search for substitutes for agar: When the supply of agar was cut off by the outbreak of the war with Japan, studies were begun to find a suitable substitute for agar in bacteriological culture medium used for counting bacteria in milk. Preliminary results indicate that a silica gel medium freshly prepared just before use from solutions of sodium silicate and an acid may satisfactorily be substituted for agar. These studies are being continued.

Mastitis work: Studies are continuing on the effect of various dairy practices on milk as determined by laboratory tests for mastitis. In connection with the work on dairy cattle breeding, feeding, and management, studies are under way to determine the effect of injecting sulfa drugs into the udder of the cow. Early results indicate that such use of the sulfa drugs on cows affected with mastitis may result in the elimination of the disease in many cases, with a subsequent improvement not only in the quality but also in the quantity of the milk produced.

Producer distribution of milk: The study of milk distribution by producers is being continued and the collection of field data is about completed. The results of this study will assist milk producers in determining the most profitable method of disposal of their product and will be of special value to them at the end of the war when market conditions may undergo a change.

Investigations of the utilization of milk in the manufacture of milk products:

The work of this project under normal conditions is designed to improve the qual-

ity of dairy products, increase the efficiency of established practices, develop new processes and products, and in general add to the information essential to the proper handling of milk and its manufacture into various products. With the advent of the war, however, the research program has been completely revised and redirected toward the war effort.

Problems which are now being given special attention are:

Conservation of cane sugar in ice cream and sweetened condensed milk manufacture: Two hundred fifty million pounds of cane sugar are used annually by the ice cream industry. Since this is a critical food material and must be conserved, all the emphasis of the research on ice cream has been directed to the conservation of cane sugar used in its manufacture and to the development of sugar substitutes. Results indicate that ice cream of satisfactory quality and without diminution in sweetness can be made with 20 percent less sugar than is customarily used, by reducing the water content of the mix and increasing the air content of the ice cream. The solids per unit volume of ice cream (the basis on which ice cream is sold) remain normal. The general use of this method, should necessity demand it, would result in the conservation of 50,000,000 pounds of cane sugar annually. Studies are also being conducted on the conservation of sugar through the use of sugar substitutes one of which is a sirup developed from milk sugar isolated from whey.

Large quantities of cane sugar are also used in the manufacture of condensed milk. New methods of processing have been developed which should make possible an increase in the solids content of this product, thus reducing proportionately the amount of sugar needed for its preservation.

Increased solids concentration in evaporated milks: A newly developed method of processing makes possible the production of evaporated milk of 20 percent greater concentration without manufacturing difficulties. The use of this development not only solves some of the present manufacturing difficulties but if used generally would result in the conservation of over 20 percent of container materials used for packaging evaporated milk, and will permit the shipment of a proportionately greater amount of milk in space now used.

Preparation and packaging of butterfat for use of military forces and in the tropics: There is an urgent need for butter that will withstand relatively high temperatures and transportation without adequate refrigeration. The use of pure butterfat (butter oil) appeared to be the solution of these problems and a method for the preparation and packaging of butter oil which will insure it against spoiling under drastic conditions of storage and transportation has been developed. The product may be used in its existing form or reconstituted into butter or milk through the addition of dried skim milk. The product is especially adapted to military and civilian uses in the tropics. Work on non-metal packages suitable for shipping the oil is now in progress.

Manufacture and packaging of dried whole milk: Large quantities of dried milk are required for lend-lease purposes. Its usefulness is limited by the relatively rapid deterioration of the fat it contains. Studies are in progress to aid the industry in the production and packaging of a product of good keeping quality.

Lacquers and resins to replace tin and rubber: Methods have been developed to effect greater utilization of the byproducts of the dairy industry in the war effort. An outgrowth of research work on lactic acid made from whey is the production of a lacquer which appears to be suitable as a substitute for tin in coat-

ing cans. Several companies are now contemplating its production. Another derivative of lactic acid when coated on paper or cloth may prove to be a substitute for containers and moisture-proof innerliners, some of which were formerly made through the use of rubber.

Manufacture of alcohol and glycerin from whey: Studies are in progress to discover methods of producing alcohol and glycerin from whey. A practical method has already been discovered to produce alcohol from this source. Work on the glycerol fermentation is in progress. Other constituents of whey are of possible value at the present time.

Separation of riboflavin (B₂) from whey: In perfecting a method for the removal of protein constituents of whey a method was devised for the isolation of riboflavin (vitamin B₂) from the whey serum. There is at present a shortage of this important vitamin. Improvement of the method of isolation is one of the objectives of the present work.

Emergency military rations: The armed forces are being assisted in some of their problems relating to the packaging of foods. Many foods have been desiccated and compressed. Combinations of foods with adequate food value and minimum bulk and weight have been prepared in attempts to develop emergency rations of various types.

Cheddar cheese quality improvement: Recently, there has been a relatively large increase in the quantity of Cheddar cheese required for lend-lease purposes. The increase in the supply cannot be accomplished through expansion because of the difficulty of obtaining equipment, and should not be accomplished in this manner at the present time because of the resulting dislocations of milk supplies now used for the manufacture of other dairy products. This situation, added to the fact that a relatively high percentage of the cheese offered has been rejected, has placed added emphasis upon the Bureau's program to assist the dairy industry in the manufacture of cheese of high quality. The research work has shown that the difficulties usually encountered can be overcome and that by following the methods developed in the Research Laboratories, 100 percent of U.S. No. 1 grade cheese, which will stand shipment and storage, can be manufactured. To the maximum extent possible with the qualified personnel available emphasis has been placed on practical assistance to manufacturers of cheese for lend-lease purchase. To date work has been carried on in seven states with excellent success. Though complete figures are not available the reports from factories in one state indicate that the quantity of Cheddar cheese of U.S. No. 1 grade in that state alone has been increased by over 1,000,000 pounds without effecting an increase in the total cheese production. Corollary laboratory studies are also being carried out to find methods to further improve the quality and hasten the ripening of the cheese.

SUPPLEMENTAL FUNDS

(Complete Bureau Statement)

Direct Allotments

Projects	: Obligations : 1942	: Estimated : obligations : 1943	: Estimated : obligations : 1944
<u>Special Research Fund, Department of</u>	:	:	:
<u>Agriculture: For special dairy cattle and</u>	:	:	:
dairy products research.....	\$58,181	\$53,020	\$53,020
<u>Working Fund, Agriculture, Dairy Industry,</u>	:	:	:
<u>Agricultural Research Administration</u>	:	:	:
<u>(Emergency Management): Development of</u>	:	:	:
dairy production and nutrition program in	:	:	:
Latin-American countries.....	1,841	20,659	-
TOTAL, SUPPLEMENTAL FUNDS (Direct allot-	:	:	:
ments).....	60,022	73,679	53,020

PASSENGER-CARRYING VEHICLES

The Bureau of Dairy Industry does not contemplate any expenditures for the purchase of passenger-carrying vehicles during the fiscal year 1944. It is expected that four vehicles will continue in operation.

AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF PLANT INDUSTRY

(a) GENERAL ADMINISTRATIVE EXPENSES

Appropriation Act, 1943	\$213,710
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-12,000
"Salaries and expenses, Library"	-18,280
Total available, 1943	183,430
Budget estimate, 1944	<u>183,430</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. General administration and business service	\$188,765	\$183,430	\$183,430	--
Unobligated balance	5,950	--	--	--
Total estimate, 1944, and comparable amounts 1943 and 1942	194,715	183,430	183,430	--

WORK UNDER THIS APPROPRIATION

This appropriation provides for the direction of the research work of the Bureau of Plant Industry, general administration and supervision of fiscal, property, and personnel work, and the administrative review and preparation of research and other publications.

(b) CEREAL CROPS AND DISEASES

Appropriation Act, 1943	\$579,895
Proposed transfer in 1944 estimates to	
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-2,500
Total available, 1943	577,395
Budget estimate, 1944	<u>547,070</u>
Decrease (including decrease of \$1,535 travel funds returned to surplus)	<u>-30,325</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Cereal production, breed- ing, disease, and quality investigations:				
(a) Barley	\$60,000	\$56,800	\$55,300	-\$1,500 (1)
(b) Corn	144,100	160,200	151,275	-8,925 (1)
(c) Seed flax	30,500	30,410	29,330	-1,080 (1)
(d) Sorghum	24,750	34,250	32,705	-1,545 (1)
(e) Oats	39,950	39,550	34,460	-5,090 (1)
(f) Rice	43,350	41,950	39,700	-2,250 (1)
(g) Wheat	194,163	187,700	179,300	-8,400 (1)
(h) Weed investigations to develop control methods	38,375	25,000	25,000	- -
Covered into Treasury in ac- cordance with Public Law 674:	- -	1,535	- -	-1,535
Unobligated balance	5,290	- -	- -	- -
Total estimate, 1944 and comparable amount, 1943 and 1942	580,478	577,395	547,070	-30,325

DECREASE

The decrease of \$30,325 in this item for 1944 consists of \$1,535 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$28,790 distributed by projects as indicated above. This decrease contemplates curtailment in cereal breeding, disease control, cultural, and quality investigations conducted in cooperation with 15 state agricultural experiment stations and at the Plant Industry Experiment Farm.

The estimated distribution of the decrease by locations is as follows:

Arkansas, Stuttgart	\$100	Nebraska, Lincoln	200
California, Davis	350	New Mexico, Tucumanari	150
Colorado, Akron	300	North Dakota, Fargo	200
Iowa, Ames	200	Oklahoma, Stillwater	200
Kansas, Hays	200	Oregon, Pendleton	400
Manhattan	3,500	Tennessee, Knoxville	200
Louisiana, Crowley	450	Texas, Beaumont	300
Maryland, Beltsville	17,590	Big Spring	150
Minnesota, St. Paul	3,400	Chillicothe	200
Missouri, Columbia	400	Dalhart	150
Montana, Bozeman	150		

28,790

Objective: The central purposes of the work on cereal crops are to insure the production, under wartime shortages of labor, equipment, and fertilizers, of the increased quantities of grain and seed flax needed by the United States and her Allies for food, feed, alcohol, drying oil, and other industrial purposes, and to improve the value of these crops for special needs. More specific objectives are (1) to adapt cultural, cropping, and harvesting methods so as to meet emergency conditions; (2) increase and distribute new varieties better adapted to avoid the diseases and other hazards threatening production in different parts of the country; (3) develop methods for controlling diseases and pests; (4) develop varieties with special characteristics (such as corn and sorghum with waxy starch) to meet new industrial requirements or to fill requirements previously met by imported products; and (5) devise practical systems of culture, cropping, and chemical treatments for the control of noxious weeds which threaten wartime production and increase its costs.

The Problem and its Significance: Unpredictable fluctuation in the yield and quality of the grain crops is a seriously disturbing element in our national economy, even in normal times. Failure to get maximum production of needed crops under war shortages of labor, equipment, and fertilizers may be extremely serious. Most of these fluctuations are due to losses from diseases and insect pests, and to the effects of cold, heat, or drought. As an example, stem rust of wheat in 1904, 1916, 1935, and 1937 caused losses in excess of \$100,000,000 each year. In 1938 a combination of stem rust, leaf rust, and heat resulted in an equally serious cut in spring wheat and oat yields. In the winter of 1939-40, nearly 20 per cent of winter wheat sowings were lost from winter-killing. The normal loss amounts to 10 per cent. Other diseases and heat and drought are added hazards. Destructive new diseases are introduced from foreign countries from time to time, and old diseases cause more severe losses as soil conditions, such as humus and plant food content and attendant physical conditions, change with longer cultivation of farm lands. The seriousness of disease losses is increased by the fact that such losses are not equally distributed, but may wipe out almost the entire crop of individual producers or even entire producing sections.

Research has demonstrated that breeding can develop for each area strains of the different crops, which because of disease resistance or better adaptation to other prevailing conditions, may greatly reduce fluctuations in yield and quality. Improvements in cropping and cultural methods and seed treatments also reduce hazards; for example, proper methods and time of seeding will reduce losses from winter-killing. Proper attention to all of these considerations opens the way through research for more certain production of these basic crops. The importance of certain cereal products is increased during the emergency by the possibility of their use as substitutes for essential plant materials no longer available from imports, as for example, waxy corn and sorghum to replace waxy starch formerly obtained from cassava grown in the Orient.

Weeds are estimated to cause an annual loss through reduced yields, lower crop quality, and costs of control, etc., in excess of \$1,000,000,000, and by some authorities as much as \$3,000,000,000. Noxious weeds, particularly difficult to control, threaten the continued use of extensive valuable meadows. Land values, tax structures, etc., are seriously impaired by these pests.

General Plan: Research on improvement in cultural and cropping methods, disease control, breeding, and on methods to avoid various hazards, is conducted throughout the United States in the regions where the different crops are important. This includes work at central points where special equipment is made available for intensive studies on diseases and for developing information on cold, heat, and drought resistance for field use and in the breeding program, and also work in the field. During the war emergency, special emphasis is being placed on making available to farmers and agricultural workers information on problems brought about by shortages of labor, fertilizers, seed, metallic fungicides, etc. Technical information and assistance are given to the action agencies in developing production goals, fertilizer allotments, and similar programs. Arrangements are made, in cooperation with other Federal agencies and with state experiment stations and extension services, to insure adequate wartime seed supplies of improved cereal varieties, and to increase as rapidly as possible seed of new improved types. The completion of certain phases of work and the discontinuance for the emergency period of phases of work less directly connected with the war effort have made it possible to handle the new work with existing facilities.

The entire program is cooperative with the state agricultural experiment stations, and much material and information are supplied to the state stations even when there is no formal cooperation. Formal cooperation is maintained with the states and work is conducted in New York, West Virginia, North Carolina, Georgia, Tennessee, Mississippi, Louisiana, Arkansas, Missouri, Ohio, Indiana, Illinois, Wisconsin, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Arizona, California, Nevada, Utah, Idaho, Montana, Oregon, and Washington.

Examples of Progress and Current Program: Examples of recent accomplishment are cited to show progress on one or more phases of the broad problem involved. Other phases of the general problem are indicated which require attention.

Barley investigations: The increased production of livestock as a part of necessary agricultural readjustments in the South requires increased production of feed crops. Winter barley is one of the best yielding sources of concentrate feed for the South, and is also a good winter

cover to prevent erosion. Through existing agencies in the several states, arrangements were made during the current season to locate and certify ample seed stocks of the best adapted improved varieties of winter barley and to insure that such stocks were sown in the fall of 1942. The same general program is being emphasized in all barley-producing areas.

A new smooth-awn winter barley, named Texan, superior to other varieties hitherto tested or grown in the central Texas blackland area, is being made available to farmers in that area. The superior characters of Texan are its smooth awns, resistance to mildew and net blotch diseases, and higher yield. The smooth-awned character is of particular interest to stockmen, since varieties now grown in the area are rough-awned. Rough-awned barley, when fed as unthreshed grain, is disagreeable to livestock and often causes sore mouths. The breeding of winter varieties to develop types adapted to different areas of the South, resistant to the smuts, mildew, leaf rust, and stripe, superior for pasture, winter cover, and grain production, and more resistant to winter injury is being pressed.

Corn investigations: To insure meeting production goals of feed crops, especially corn, certain lines of work have been expanded and some new lines have been started. These new and expanded lines of work have been cared for within current appropriations because of the completion of certain phases of work and the curtailment of others. Work on the Pythium stalk rot of corn and the locating of inbred lines resistant to it, certain phases of which have been completed is being suspended for the time being. Work on developing more simple methods of testing inbred lines in producing hybrid seed corn also has been curtailed. Studies on the mineral nutrition of corn and the production of useful hereditary characteristics in corn by X-ray and other radiations, of great value in the long-time improvement of agriculture but not immediately urgent, are likewise being curtailed during the emergency.

Reserve hybrid seed stocks. Since 1935 when the first appreciable plantings of hybrid corn were made, the acreage has increased as rapidly as seed was available. In 1942 about 41 million acres or 45 percent of the national acreage was planted with hybrid seed. The percentages in Iowa, Illinois, and Indiana were 98, 93, and 91, respectively. On the average the hybrids have outyielded open-pollinated varieties by 15 to 20 percent. The Bureau of Agricultural Economics estimates 300,000,000 bushels more corn were produced in the 12 Corn Belt States in 1942 than would have been produced had open-pollinated varieties been grown. This increase required no additional labor, fertilizer, or equipment except to harvest and store the larger yield.

The growing of corn hybrids is essential to meet production goals during the emergency. Large producers of hybrid seed carry reserves of inbred lines and single crosses, but about half the hybrid seed is grown by small producers who have not been able to build up seed reserves due to rapid acreage expansion. A poor season for the production of seed stocks of inbred lines and single crosses would result in a very critical shortage of hybrid seed and would endanger national production. In case of such a catastrophe it would require two or three years to again build up supplies. As insurance against such an occurrence, contracts were made during the current season by the Commodity Credit Corporation with growers in the Corn Belt States

to produce under supervision of the Bureau of Plant Industry reserve stocks of single cross seed. All of this seed belongs to the Commodity Credit Corporation to be held as a reserve and sold only as needed for planting. Arrangements were also made to grow reserve seed of parental inbred lines at cooperating state stations.

Waxy corn. Supplies of tapioca starch, no longer available from the Orient can be replaced for food and industrial uses by starch from waxy grains, including corn. Adapted waxy corn hybrids (Waxy Iowa Hybrid 939) developed in cooperative breeding work at Ames, Iowa, were increased in the green-houses at Beltsville during the winter of 1941-42 and in the field during the summer of 1942. The two generations increased in 1942 have made available seed of this waxy hybrid for commercial production in 1943. Special attention is being given to further increasing seed stocks for any expanded commercial production that may be necessary.

Corn diseases. Non-metallic fungicides are being tested for seed treatment of corn to determine substitutes for the materials now in use that contain copper or mercury.

Corn insect resistance. The recent rapid spread of the corn borer across Illinois into Iowa and elsewhere is a serious threat to the maintenance of maximum corn production. In order to avoid insofar as possible heavy insect losses, seed of several inbred lines found to transmit some resistance to corn borer damage was increased in 1942. Seed supplies for commercial use are being developed as rapidly as possible. Special emphasis is being placed on the breeding program to develop more highly resistant hybrids adapted to the infested areas.

Hybrid corn for the South. The development of insect and disease resistant hybrids adapted for growing in the South is being given special emphasis in order to increase the production of feed necessary for the increasing number of livestock in this area.

Flax investigations: Special attention is being given to increasing seed of the new disease-resistant varieties Biwing in Minnesota and Zenith in North Dakota to help meet the shortage in drying oils. In addition to being resistant to wilt and rust, these varieties produce high yields of seed and oil of good drying quality. The variety Zenith is exceptionally wilt-resistant, and is resistant to common races of rust, which latter disease was serious in some areas in 1942. The combining of resistance to wilt rust, pasmo, and canker remains one of the principal objectives of the cooperative improvement program.

A new industry, the manufacture of cigarette paper from flax straw, has developed in this country during the past five years. Previous to the present world conflict, cigarette paper, made largely from linen rags and flax tow from linen mills, was largely imported. The sale of flax straw now provides an additional source of income to domestic seed-flax growers. It is estimated

that in 1941 a total of about 400,000 tons of flax straw was processed for paper making. Threshed seed-flax straw yields about 10 to 20 per cent of tow. Cooperative experiments are under way to determine yields of tow from different varieties grown under different environmental conditions.

Oat investigations:

Seed stocks of improved varieties. Through existing agencies in the several Southern States, arrangements were made during the current season to locate and certify adequate seed stocks of improved disease-resistant winter varieties adapted in the different areas and to insure that such stocks were held for seeding this fall. For one area in north-central Texas, devastated by the greenbug, it was necessary to arrange for securing seed from the Delta area of Mississippi, Louisiana, and Arkansas.

The new rust and smut resistant varieties of oats, developed in cooperative experiments in Iowa and distributed in the Corn Belt in 1939, performed so outstandingly in 1942 that it is estimated they will be grown on 95 per cent of the oat acreage in Iowa in 1943, with only a slightly smaller percentage in other states. These varieties are controlling the races of smut and rust now prevalent in the Corn Belt so well that it is possible to give more attention to the problems in connection with feed grain production in other areas.

Two new hardy, highly productive varieties of winter oats, Pioneer in New Jersey and Wintok in Oklahoma, have been increased for distribution. These varieties were selected by the respective state experiment stations from hybrids made by the Department at Arlington Farm, and both have shown 5 to 10 per cent higher average winter survival than established fall-sown varieties in these areas.

New winter varieties resistant to crown rust and smut are producing high yields and quality in tests in certain sections of the South, where improved winter types are needed to provide soil cover to prevent erosion, to furnish fall, winter, and early spring pasture, and to supply hay and grain feed. Two were distributed to farmers in North Carolina in the fall of 1941, and other selections were increased for distribution in the fall of 1942 in Georgia and Arkansas. Some of these new strains have been outstanding in tests on clipping for processing into green grass products for use as high vitamin foods and feeds.

Rice investigations: Special attention has been given to increasing and distributing seed of new disease-resistant varieties. The increased and stabilized production from these varieties should help to meet the production goals for this crop. Arrangements have also been made to increase seed of waxy varieties of rice so that they could be put quickly into commercial production if waxy rice starch should be found to have equal or better properties than the other waxy cereals.

Sorghum investigations: As mentioned under corn and rice, starch from waxy grains can replace that from tapioca. Waxy sorghum is available in commercial quantity at the present time. Special attention was given to location of pure seed of Leoti, the principal commercial variety with waxy grain, and to increasing its acreage in Nebraska and Kansas in 1942. It is estimated that over 200,000 acres of waxy sorghum, mostly of the Leoti variety, were grown in 1942. Starch from this crop could fill a substantial part of domestic needs, and is already being utilized in the food industry to replace tapioca.

White grain types with the waxy starch superior in quality to that from Leoti have been produced by breeding and some were increased in 1942 for further tests on starch quality, and for distribution.

Several new non-metallic fungicides are being tested on sorghum and other grains to determine their effectiveness for disease control and their effect on seed germination. If they prove to be as satisfactory as preliminary tests seem to indicate, they can well replace commercial fungicides containing mercury and copper for seed treatment.

Four new, early-maturing, dwarf-type grain sorghums are meeting a demand for varieties that can be harvested with a combine in South Dakota, Nebraska, northeastern Colorado, and northwestern Kansas. These combine varieties are of special value in meeting production goals for this crop under the shortage of farm labor. They have expanded the area in which combine types of grain sorghum may be grown by about 75,000 square miles. As a step in further improvement of these new combine types, promising selections having resistance to Pythium root-rot, a disease causing severe losses in recent years, are being increased and distributed. As a result of cooperative experiments in Texas and Oklahoma, the varieties Bonita and Cache Pendergast, resistant to chinch bugs and charcoal rot as well as Pythium root-rot, are being distributed to farmers.

Wheat investigations: Special attention is being given to increasing for commercial production new varieties resistant to stem and leaf rust, to insure against serious losses from these destructive diseases. Precautions are also being taken to bring all known factors for rust resistance into the breeding program as insurance against the appearance of new rust races that might attack varieties previously resistant. Through existing agencies in the Southern States, arrangements were made to locate seed of the best available varieties and insure its being held for planting this fall.

Arrangements have been made for special investigations on the vitamin and mineral content of grain and flour from wheat varieties and on the various fractions of mill products because of the relation they may have to proper nutrition. The milling and baking laboratory of the Agricultural Marketing Administration, with which the Bureau of Plant Industry is cooperating, has evaluated many samples of wheat, flour, and baking ingredients in connection with Lend-Lease purchases.

Two new varieties of hard red winter wheat, Comanche and Pawnee, are being increased for distribution to farmers in the Great Plains, the first in Texas, Kansas, and Oklahoma, and the second in Nebraska and probably also in Kansas. Both were among the highest yielding varieties in experimental trials during the past three years. Both are resistant to leaf rust which in recent years has taken a heavy toll in the hard red winter wheat area. Pawnee is also moderately resistant to the Great Plains strain of hessian fly. It ripens early, has a good test weight, and appears to be equal to Blackhull and Turkey in bread-making quality. Comanche is resistant to bunt and stem rust, but susceptible to loose smut, hessian fly, and winter-killing. It is anticipated that each variety will fill a need in the areas where they are being increased for distribution.

Leaf rust exacted an almost unprecedentedly heavy toll among the commonly grown varieties in the northern spring wheat region in 1941. In the Red River Valley, the resistant varieties of spring wheat, Pilot and Rival, yielded 8 to 10 bushels an acre more than the very generally grown but leaf rust susceptible Thatcher. Pilot and Rival recently were released for growing by farmers, and probably nearly 2,500,000 acres of the two varieties were grown in 1942. These varieties were developed in cooperative experiments in North Dakota. The stem rust resistant Thatcher continued to give satisfactory yields in the drier western Great Plains where leaf rust did little damage. Developed in cooperation with the Minnesota Agricultural Experiment Station and distributed in 1935. Thatcher is now the leading spring wheat in the United States and Canada. Experience with leaf rust however, with this otherwise outstanding variety, illustrates the necessity for constant effort in the breeding program.

The dwarf bunt resistant Turkey type winter wheat, Relief, produced cooperatively with the Utah station, has replaced considerable acreages of susceptible varieties in northern Utah and southern Idaho with a consequent reduction in bunt losses. Former heavy losses from bunt in the Pacific Northwest have been reduced to a nominal figure, in considerable part by the introduction and growing of resistant varieties. In portions of Utah, Idaho, and Montana, however, losses are still heavy because of the presence of the dwarf bunt to which few varieties are resistant. Several new varieties resistant to this disease are now being tested, and possibly some may be adapted to areas in which Relief has not proved entirely satisfactory.

Weed investigations: Recommendations for the control of noxious perennial weeds, particularly bindweed, have been greatly modified and the cost and labor for control reduced by nearly one-half as a result of recent cooperative studies on the storage of root reserves combined with experiments on tillage and competitive crops. Special attention is being given to making this information available to experiment stations and extension workers and to farmers. Attention has also been directed to conserving the use of critical sodium chlorate for weed control, to assistance in developing supplies and the rationing of this chemical, and to investigating the possibility of utilizing other available chemicals, either alone or in mixtures with chlorate.

Cooperative experiments have shown that a few crops can compete with bindweed, but none can destroy it. Crop yields on bindweed land vary from nothing, in many cases, to almost 100 per cent of normal for alfalfa under good conditions. Combinations of tillage and winter grain crops are showing wide usefulness in bindweed control. One season of intensively cultivated fallow followed by two years of rye or winter wheat with intensive tillage between crops kills bindweed, or nearly so, in three years. Winter barley is less effective. Combinations of tillage with certain summer crops appear to be almost as effective. Work is continuing to develop cropping systems for bindweed control in different areas, including modifications of the best systems for control into practical systems to permit profitable production and provide assured bindweed control. Much remains to be done on other noxious weeds, such as whitetop, Russian knapweed, Johnson grass, prickly pear, and others.

(c) COTTON AND OTHER FIBER CROPS AND DISEASES

Appropriation Act, 1943	\$448,355
Proposed transfer in 1944 estimates to "Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-2,000
Total available, 1943	<u>446,355</u>
Budget estimate, 1944	<u>422,940</u>
Decrease (including decrease of \$1,155 travel funds returned to surplus)	<u>-23,415</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Cotton investigations:				
(a) Cotton breeding and improvement investigations (including \$14,700 for Sea Island cotton)	\$194,844	\$176,500	\$164,900	-\$11,600
(b) Cotton quality investigations	51,600	54,300	52,050	-2,250
(c) Cotton disease investigations	43,900	45,200	41,830	-3,370
(d) Cotton culture, fertilizer, and nutrition investigations	46,600	27,200	22,880	-4,320
(e) Farm use of improved seed stocks, and one-variety community organization	77,800	80,500	79,780	-720
Total, cotton investigations	414,744	383,700	361,440	-22,260(1)
2. Fiber plants other than cotton:				
(a) Hard fiber investigations (abaca, sisal, henequen, yucca, etc.)	9,287	13,050	13,050	- -
(b) Hemp, flax, ramie, urena, crotalaria, and miscellaneous fiber investigations	11,575	48,450	48,450	- -
Total, fiber plants other than cotton	20,862	61,500	61,500	- -
Covered into Treasury in accordance with Public Law 674	- -	1,155	- -	-1,155
Unobligated balance	9,054	- -	- -	- -
Total estimate, 1944, and comparable amounts, 1943 and 1942	444,660	446,355	422,940	-23,415

DECREASE

The decrease of \$23,415 in this item for 1944 consists of \$1,155 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$22,260 under Project 1, Cotton investigations, estimated by work projects as indicated in the project statement. This decrease contemplates curtailment in cotton improvement, quality, disease, and cultural investigations, estimated by States as follows:

Arizona	\$2,500	South Carolina	3,100
Louisiana	250	Tennessee	2,400
Mississippi	100	Texas	6,500
North Carolina	350	Maryland	<u>7,060</u>
			22,260

WORK UNDER THIS APPROPRIATION

General: Much of the work done under this appropriation pertains to cotton, its production, improvement, and diseases, while a smaller proportion pertains to other fiber crops such as hemp, flax, abaca, sisal, and henequen. The work with cotton, therefore, is discussed at some length, yet the other fiber crops are of such significance during the war that they are emphasized in separate paragraphs.

Objective: (a) The principal objective in connection with cotton under war conditions is to increase production of the kinds and qualities needed for making war materials, by improving fiber quality, by developing effective disease-control measures, and by devising cultural methods that will increase efficiency of production while insuring to manufacturers of war materials the desired quality and uniformity of product.

(b) With shortages of the important fibers formerly imported, another wartime objective is to increase the production in the United States or elsewhere in the Western Hemisphere of abaca, hemp, sisal, and other fiber that have a high use-value in prosecuting the war.

The Problem and its Significance: (a) Cotton normally is the most important agricultural export from the United States, and during war it is one of our most important raw materials. A shortage exists in supply of the better grades of long staple cotton used for balloons, parachutes, rafts, tires, and other essential war uses. An American soldier on combat duty requires the equivalent of about 150 pounds of cotton for his equipment and maintenance, and some 250 items used by the military personnel are made from cotton. More than 1,000,000 bales of linters are used in making cellulose for explosives and for other purposes. Cottonseed oil is of first importance in our supply of vegetable oils, and more than 2,000,000 tons of cottonseed meal are used as the principal concentrated protein feed for milk and beef production.

Cotton is the principal source of income for one-third of the total farm population of this country. How to keep the cotton-producing industry on a profitable basis and supply the kinds and qualities of cotton needed in making war materials is, therefore, a question of primary importance. Our own war requirements and needs of our Allies are becoming increasingly exacting. This means that producers of cotton must pay more attention than ever before to ways of increasing quality and the production of needed types.

(b) The United States annually imports between three and four hundred million pounds of abaca, sisal, and henequen, some ten million pounds of flax, and over a million pounds of hemp, for use in manufacturing rope, marine cordage, binder twine, textile fabrics, and other materials. During the war these requirements have greatly increased, and normal sources of supply have been cut off. Most of the abaca and sisal have heretofore been imported from the Orient and East Africa, and the flax and hemp from Europe. The problem confronting the United States is thus one of establishing in this country, or elsewhere in the Western Hemisphere, adequate, dependable supplies of these essential plant fibers or of suitable substitutes.

General Plan: All cotton improvement and production work, involving both field and laboratory experiments, is cooperative with the state agricultural experiment stations of the Cotton Belt, which act as a group in conformity with a coordinated plan of procedure. Certain fibers research is cooperative with the Bureau of Agricultural Chemistry and Engineering. Other cooperation is with the Bureau of Entomology and Plant Quarantine, with the Extension Service, and with agencies using cotton in making war materials.

With fibers other than cotton, cooperative field investigations are made when advisable in foreign countries. Work with fibers in this country is cooperative with state experiment stations and various Federal agencies and commercial interests. Work with tropical plants, such as abaca, is cooperative with countries of Central and South America and with plantations operated in those countries.

Examples of Progress and Current Program: The greater part of the Bureau's research program on cotton and other fiber crops is contributing definitely to meeting certain important war needs. This part of the program is going forward with only minor shifts, since the added war contributions can in large part be made by directly applying results already obtained and by following up important leads already developed. In some cases the men working on long-time projects with cotton are being shifted to work on other fibers that are badly needed at this time. Close cooperation is maintained with the War Production Board and the Army and the Navy through the Office for Agricultural War Relations of the Department, and with several other bureaus and agencies of the Department such as the Commodity Credit Corporation,

Agricultural Conservation and Adjustment Administration, Office of Foreign Agricultural Relations, and the Agricultural Marketing Administration, as well as with state and commercial agencies working on special war problems.

Cotton investigations: The war needs for cotton are quite different from civilian needs. At present special qualities of cotton are needed for khaki and other service clothing, canvas, bagging, webbing, belts, straps, cord and twine, tire cord, barrage balloon cloth, man-carrying balloon cloth, life rafts, flotation gear, airplane covers, strong thread substitutes for silk, and other essential war, industrial, and civilian textile uses.

Sea Island cotton with 2" staple. The war has emphasized the need for greater length in Sea Island strains, and two new strains developed in the breeding work are already in production this year. Others are being increased for production in the immediate future. Early last year our Navy indicated a need for extra long Sea Island with staple 2" and longer, and since cotton of this length had been produced in the past only in the British West Indies, it was necessary to do rather intensive work on this problem. The Puerto Rican Experiment Station, however, working in cooperation with this Bureau, had developed a 2" strain which was being produced on a small scale in Puerto Rico. Now, increased, this stock is apparently sufficient to meet the immediate needs for balloon cloth for man-carrying balloons. Small plantings of 2" stock are being made in Florida and in Texas so that production can be increased in these areas if necessary.

Increased production of American-Egyptian. Probably the most urgent fiber need that has developed within recent months is that for large increases in the production of American-Egyptian cotton in our southwestern states. Recently the Bureau of Plant Industry developed a strain with superior fiber structure and strength which is being accepted by spinners as a substitute for Egyptian growths and is now being brought into large-scale production. Production of this cotton is being increased in 1942 to an estimated 100,000 bales where only 61,000 bales were produced last year. An intensive seed program is under way to provide seed for planting a still larger acreage next year. Several new strains are also being increased this year, preliminary spinning tests having indicated that they are the equal of the best Egyptians.

Extra-long staple upland cotton. The need for large increases in production of the longer lengths of upland cotton for certain war materials has created a rather acute problem. The normal domestic consumption of cotton of staple lengths between 1-1/8" and 1-3/8" is about 700,000 bales. The need for the current year are estimated at about 1,400,000 bales. Intensive surveys of available seed stocks and close cooperation of the agencies responsible for increasing production gave a sufficient increase in acreage to produce a part of this need. The situation will probably remain acute for the next year. Every effort is being made to increase seed stocks of the better varieties of these staple lengths, and the new strains which have been developed and are now being increased will be placed in production to help supply this wartime need.

Better medium staple cotton. The large increase of our better medium staple cottons 1 to 1-1/8 inches in length under standardized production in one-variety communities is helping to supply the need of cotton of special character for particular war materials. Our researches have demonstrated that certain of the varieties now grown in these one-variety communities produce yarns from 15 to 20 per cent stronger than those produced from other varieties of equal length. The demand for these stronger cottons of better character is intensified by war needs. There are now 2,220 one-variety communities operating in 550 counties in 17 cotton-producing states involving 6,124,162 acres and a production of 3,361,606 bales. Special war needs are being studied and shifts of varieties planted in these communities are being planned so that there will be increased production of the varieties that are most needed. Recently developed X-ray and laboratory techniques for measuring strength and other fiber properties are being used to determine the probable use value of the varieties in production and of the new selections and strains which are being increased to go into war materials.

Cotton soil fertility. Information from experiments under way is proving helpful in the judicious allocation of nitrogen to various areas in the Cotton Belt. The shifts to peanuts and soybeans have intensified some of the fertility problems, particularly with reference to potash and lime. In certain areas cotton and peanuts come in rotation, and the fertilizer needs of the two crops are so different that special nutrition difficulties are being encountered. The work with cover crops and winter legumes is yielding results which contribute materially to meeting the nitrogen shortage. These experiments and demonstrations are being expanded to gain additional information for meeting the fertility problems during and after the war.

Fiber plants other than cotton: Seven of the plant fibers other than cotton, including abaca, sisal, henequen, flax, hemp, jute, and kapok, are now either strategic or critical raw materials. With the exception of henequen, flax, and hemp, our supplies of these fibers have been obtained mainly from the Far East. Some of the sources of supply have been entirely eliminated, and others are now seriously threatened. An adequate supply of these fibers is essential to the continued production of many different materials used in military operations, and existing stocks are now being rapidly exhausted.

The increased production of these fibers, or of acceptable substitutes, either in the United States or in other countries of the Western Hemisphere, has become a vitally important war problem. The fiber specialists of the Department have been in constant touch with the different war agencies of the Government, and in addition to the work conducted within the Department, have assisted these agencies in formulating their fiber programs. Scientists have been temporarily assigned from other investigations to work on these special fiber problems.

Abaca. One of the most critical fiber problems is that relating to future supplies of abaca. This fiber furnishes the material for the manufacture of marine cordage and other high-grade rope. Our entire supply of this fiber has heretofore been obtained from the Orient, principally from the Philippine Islands. Fortunately, the Department had introduced this plant into the American Tropics and an abundant supply of planting material is now available. Arrangements have been made with an American plantation company for the development of a large abaca project in Panama and Costa Rica. Planting is now under way, the program involving 10,000 acres in Panama and another 10,000 acres in Costa Rica. Similar projects for Guatemala and Honduras are under consideration. Plantings now being made will begin to produce fiber the latter part of 1943, and with estimated production 20,000 acres should furnish approximately 20,000,000 pounds of fiber. American hemp, produced by the plant Cannabis sativa, is considered to be the most satisfactory substitute for abaca in the manufacture of marine cordage.

Hemp. The War Production Board, recognizing the seriousness of the cordage fiber situation at the beginning of the current season, instructed the Secretary of Agriculture to arrange for growing some 30,000 acres of hemp to provide seed for an enlarged future hemp fiber program. This project was successfully carried out. The War Production Board has now instructed the Secretary to have grown in 1943 some 300,000 acres of hemp for fiber and 50,000 acres for seed, the first to supply fiber to replace strategic and critical supplies no longer available as imports, and the second for even larger future plantings. The Bureau of Plant Industry is supplying the necessary information to grow and handle this material in the field. During the current season test plantings have been conducted to locate the areas best suited for this large acreage, and these will be continued and enlarged to determine areas for further expansion in line with War Production Board instructions. Since this program must be carried out by growers entirely unfamiliar with the crop, and in areas where hemp has not been grown to any great extent, much intensive investigational work must be done quickly, and its results must be made promptly available to growers. The Bureau is cooperating closely in supplying necessary information and technical assistance to the Commodity Credit Corporation, the Agricultural Adjustment Agency, and the Extension Service, charged with the action program.

Sisal and henequen. These fibers furnish the raw material for binder twine and many other types of cordage, and are not produced in the continental United States. With respect to the increased production of these fibers, the Department has cooperated with other agencies that are directly concerned with fiber production in the Latin American countries. New plantings of sisal are being made in Haiti, and improvements are being made on the henequen plantations of Mexico.

Yucca fiber. In the southwestern states there are large areas of wild yucca plants, the leaves of which contain fiber. As there seems to be a possibility that this fiber can be produced in commercial quantities, work on this problem has been started.

Sansevieria. This plant grows wild in Florida and is also cultivated there as an ornamental. It produces a fiber which can be used in the manufacture of cordage of a type for which there is urgent need. In view of the fiber possibilities of this plant from a war standpoint, experimental work is being undertaken in Florida at the suggestion of the War Production Board to determine the conditions of production, the relative value of different species, and other factors involved.

Fiber flax. An increased acreage is being planted to fiber flax in Oregon, and both Peru and Canada will be able to furnish supplies of this fiber. The Department work is now concentrated on the development of increased production in the United States, and on cooperative work with agencies concerned with the production of fiber flax in other American countries.

Jute and kapok. Commercial production of jute appears to be impracticable in the continental United States, but there are several substitutes that might possibly be produced in this country. These include Crotalaria, Hibiscus and Urena lobata. Experimental plantings of these plants are now being made in the southern states. The development of the production of kapok, or of substitutes for this fiber, is being encouraged by cooperative work with war agencies.

Loofahs (vegetable sponges). To meet military needs, the Bureau has cooperated with the Navy Department and commercial organizations in the production in the United States and in Latin American countries of loofahs, or vegetable sponges, to replace the supplies formerly imported from Japan for certain critical naval uses.

(d) DRUG AND RELATED PLANTS

Appropriation Act, 1943	\$65,890
Budget estimate, 1944	<u>62,250</u>
Decrease (including decrease of \$360 travel funds returned to surplus)	<u>-3,640</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Drug, oil, insecticide, tannin, flavoring and re- lated plant investigations	\$51,895	\$54,585	\$51,855	-\$2,730
2. Hop production, breeding, disease, and quality inves- tigations	10,545	10,945	10,395	-550
Covered into Treasury in ac- cordance with Public Law 674:	- -	360	- -	-360
Unobligated balance.....	3,180	- -	- -	- -
Total estimate or appro- priation	65,620	65,890	62,250	-3,640

DECREASE

The decrease of \$3,640 in this item for 1944 consists of \$360 decrease in travel funds (returned to surplus in 1943) and the following decreases:

(1) Drug, oil, insecticide, tannin, flavoring and related plant investigations, \$2,730. This decrease contemplates curtailment in work with drug plants, condiment plants, and castor beans at the Plant Industry Experiment Farm and in Kansas, Illinois, Missouri, and Texas.

(2) Hop production, breeding, disease, and quality investigations, \$550. This contemplates curtailment in hop improvement and disease control investigations in Oregon.

The estimated distribution of the decrease by States is as follows:

Illinois	\$100
Kansas	100
Maryland	2,380
Missouri	50
Oregon	550
Texas	100
	<u>3,280</u>

WORK UNDER THIS APPROPRIATION

Objective: (1) As a means of insuring supplies of certain critical drug, insecticide, tannin, paint and varnish oils, condiment, and related plant products, it is necessary to determine the regions with suitable soil and climatic conditions for production of such crops; to determine and supply as far as practical, information useful and necessary to introduce and maintain in the United States a commercial production of plants that furnish the raw materials for these commodities needed in the war effort; (2) to develop varieties of hops resistant to downy mildew and other diseases, and that produce higher yields of superior quality hops; and to determine non-critical spray and dusting materials effective in controlling downy mildew of hops to increase production for domestic consumption and to replace supplies of a high quality formerly imported.

The Problem and its Significance: In the past the industries in the United States which manufacture medicines, insecticides, leather, flavoring extracts, paints, varnishes, linoleum, perfumes and related products, have been dependent to a very large degree on foreign sources for the plant materials that go into such manufactured articles. With the present disruption of world trade their procurement is now greatly limited and entirely impossible for many materials. Many of the plants from which the desired materials may be obtained have been introduced in the United States and found to be adapted to growing conditions in certain sections of the country, and some native plants are potential sources for the production of these critical materials. However, the culture and production requirements of this group of plants are not well known, and often are entirely unknown.

The quality of most crude drugs and related products is affected by practices in growing, harvesting, curing, baling, and storing the crop. It is necessary therefore, to determine the degree and importance of these relationships in order to guide growers, most of whom are not familiar with these crops.

Drug plant materials collected from widely diverse parts of the world vary greatly in quality. Adequate information on growing drug and related plants in this country with reasonable profit, will insure more dependable sources of raw materials of better and more uniform quality, necessary for many drugs. Although such new crops need to be expanded only on a limited scale, they are important from the standpoint of providing our needs of critical materials.

The American hop crop has a market value of over \$10,000,000 annually. American brewers in the past have imported annually from six to eight million pounds of European hops which they claim are superior. These normal sources of supply are now cut off and it is necessary to increase the quality fractions of the domestic hop crop if usual market demands are to be supplied. There is increasing competition among domestic buyers now

in an attempt to secure high quality seedless hops of domestic production which are now replacing such materials formerly imported from Europe. If the domestic crop can be further improved through introduction or development of new varieties which are not only disease resistant but compare in quality with the preferred European type, domestic production can be increased by the amount of these imports.

In the control of hop diseases certain materials used in sprays and dusts are on the list of critical war materials, and others are impossible to obtain. It is now necessary to ascertain what substitute materials are available that will satisfactorily prevent and control disease.

General Plan: The work involves four distinct phases (1) a critical review of experimental work conducted in the past on such specialized crops as are now needed in the war effort in order to determine the regions most suitable for immediate domestic production; (2) field guidance and further work on the immediate production problems pertaining to propagation, culture, harvesting, curing, distillation and other processes; yields, and production expenses; (3) laboratory examination of materials to determine their quality and the relation of various conditions and practices to quality; and (4) development of varieties and types of superior quality and greater disease resistance. Since many species are involved, with possible adaptation to a wide range of conditions, the field work must be done in numerous locations throughout the United States. Most of the laboratory work and some field work is conducted at Beltsville, Maryland; however, most of the cultural, selection, and breeding work is conducted at Bureau of Plant Industry field stations and through cooperation with the various state experiment stations. Cooperation with growers is maintained for guidance and for solutions of new problems as they arise in the production of a new crop.

The investigation of hop disease problems, field control measures, and the breeding work are centered at Corvallis, Oregon, and conducted in cooperation with the Oregon Agricultural Experiment Station, with close cooperation with growers and county agents elsewhere in the State and in California and Washington. Three experimental hop yards totaling 7 acres are maintained for this purpose, and greenhouse and laboratory studies are conducted in connection with the field work.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited to show progress on one or more aspects of the broader problems confronted. Other aspects of these problems are cited as indicating the next logical steps to be taken in a research program.

Drug, oil, insecticide, tannin, flavoring, and related plant investigations: Cutting off supplies of essential drug, oil, and insecticide materials heretofore imported has necessitated a shift in the work under this appropriation to meet the emergency. This has required a critical

examination of data from previous experimental work in order to make an immediate determination of areas where these crops can be grown, building up seed supplies, and rapidly accumulating information on culture and other practices necessary for the successful production of these specialized crops. Technical service and guidance as is necessary is being given to growers in order to assure a product of suitable quality and in sufficient quantity to meet the critical need.

Morphine: In cooperation with the Bureau of Narcotics, areas in the United States have been determined where opium poppy can be grown successfully as either a summer or winter crop. Methods of growing and handling the crop and for controlling diseases are being developed. Seed to plant the several thousand acres required to supply our needs has been produced and is being held for use if necessary. Better varieties have been selected and seed of these varieties is being increased in test plots of considerable size in order to determine more efficient cultural practices. It now seems possible that poppies could be started either in the spring or fall, if in the emergency it might appear necessary to provide an immediate supply of morphine.

Belladonna, henbane, digitalis, stramonium, ergot, etc.: The Bureau produced enough belladonna seed in 1941 to grow a domestic crop large enough to produce an amount equal to our usual imports. A sufficient amount of henbane seed for all needs was also accumulated. During 1942 some 600 acres of belladonna and 100 acres of henbane were grown under a cooperative agreement with some 200 growers in 5 regions believed to have suitable climatic and soil conditions as well as equipment and experience essential for the production of this new crop. The production of belladonna from this acreage has been sufficient to build up a large Government stock pile and in addition supply all of the belladonna necessary for our domestic need. Two of the areas selected gave only fair yields while three of the areas yielded more than was anticipated so that an ample amount of belladonna for both our military and civilian need is at hand. Steps have been taken to insure supplies of digitalis, stramonium, and ergot, and it now appears that these crude drugs will be available in sufficient quantity for both our military and domestic need. One important problem has been the prevention of loss through over-expansion. The need for such materials is a national problem and has created widespread interest; however, the production of such crops is limited to a small acreage where more suitable soil and climatic conditions prevail, as well as where economic factors are more favorable. Methods of culture, preparation, and disease control of all of these crops are progressing and already have resulted in war products superior to the imported drugs. For example, belladonna grown this year averages approximately twice the minimum requirement set forth in the U.S. Pharmacopoeia.

Castor beans: Tung oil, essential for naval and military use, is no longer available from the Orient. Dehydrated castor oil is the most practical substitute. Some 85 test plantings of the more promising varieties have shown areas and varieties best suited for domestic production. The Agricultural

Adjustment Agency, the Commodity Credit Corporation, and the Bureau of Plant Industry have cooperated in a plan under which approximately 5,000 acres were grown to provide seed for domestic planting in a production program if needed in 1943. In cooperation with the Bureau of Agricultural Chemistry and Engineering a castor bean huller has been developed. A sufficient number of these machines to hull this year's seed crop have been manufactured and are now in operation. The work in hulling the castor beans from the seed increase program is progressing and it now appears that sufficient seed of the pure varieties will be available to plant from 100,000 to 200,000 acres of castor beans for an oil production program next year. Work on improving cultural and handling methods and varieties is being conducted. Other drying oil crops such as safflower and perilla are being tested and their production will be encouraged if circumstances warrant.

Insecticide plants: An increasing demand for insecticide materials makes it necessary to expand the production of Tephrosia (Devil's shoestring) and pyrethrum as rapidly as possible. With the extension of military campaign in mosquito-infested countries and with the recent increased use of pyrethrum to control lice, available supplies must be augmented by greater importations or by domestic production. At the request of the Office for Agricultural War Relations, all available seed of pyrethrum was collected, and it may be necessary to arrange for a sizeable domestic acreage to supply the need specified by the Office of the Surgeon General.

Enlarged tests are being conducted to work out economical practices necessary for any rapid increase in the domestic production of Devil's shoestring as a source of rotenone. A cooperative planting is now in progress with the Farm Security Administration. Also, plans to collect and process Tephrosia from certain areas where the rotenone content is sufficiently high are under consideration in cooperation with insecticide processing concerns. Work is in progress to develop and increase superior strains of Tephrosia with high rotenone content and to develop strains of pyrethrum better adapted to machine harvesting.

Tannin plants: Assistance has been given in utilizing wild domestic sumac for tannin. Stocks of canaigre are being increased for possible use in an expanded program in the Southwest. Large field plots have been planted in order to determine more efficient mechanized methods of harvesting and handling the crop, and extensive tests on processing canaigre are now in progress in cooperation with the Bureau of Agricultural Chemistry and Engineering.

Condiment plants: Most of the condiment plant materials used in this country are imported. Encouraging progress is being made in the finding of areas suitable for growing these crops on a commercial basis and in the development of methods for handling sage, paprika, mustard, anise, caraway fennel, coriander, dill, licorice, French celery, etc. As a result of our experiments it now appears that anise, caraway, and French celery can be grown on a commercial basis as a winter crop in the Southwest. Caraway seed which has been in much demand the past year has proved to be a successful crop in the Northwest where some commercial acreages are now established.

Hop investigations: The work of the Bureau in developing and encouraging seedless hop production has been most effective in producing a superior quality of hops which are now being accepted in lieu of such materials formerly imported. With the increased demand for domestic hops, the control of diseases is becoming of greater significance due to the limitation of certain critical spray materials. Available substitute materials have been tested, and recommendations will be made available to growers before the materials are needed for application during the next growing season.

(e) DRY-LAND AGRICULTURE

Appropriation Act, 1943	\$230,788
Budget estimate, 1944	<u>219,040</u>
Decrease (including decrease of \$225 travel funds returned to surplus)	<u>-11,748</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Dry-land agriculture investigations:				
(a) Dry-land crop production investigations ..	\$206,113	\$206,888	\$195,365	-\$11,523
(b) Cooperative farm windbreak demonstrations and experimental test plantings	23,400	23,675	23,675	- -
Covered into Treasury in accordance with Public Law 674:	- -	225	- -	-225
Unobligated balance	430	- -	- -	- -
Total estimate or appropriation	229,943	230,788	219,040	-11,748

DECREASE

The decrease of \$11,748 in this item for 1944 consists of \$225 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$11,523 in dry-land crop production investigations. This contemplates discontinuing cooperative work on State Substations at Colby and Garden City, Kansas, and Moro, Oregon; and curtailment in work at Mandan, North Dakota; Woodward, Oklahoma; and Beltsville, Maryland.

The estimated distribution of the decrease by States is as follows:

Kansas	\$6,975
Maryland	1,148
North Dakota	500
Oklahoma	500
Oregon	<u>2,400</u>
	11,523

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of this work is to aid in developing a more stable agriculture under dry farming conditions in the Great Plains and in other semi-arid regions. Particular objectives are to (1) improve cultural and rotation practices that will make possible the most efficient use of limited rainfall on different soil types for cash-crop and livestock production, (2) develop methods and materials for successfully growing farm windbreak and fruit and vegetable gardens, (3) increase and distribute seed of improved and special-purpose crop varieties, (4) test and give advice on new crops for supplying war needs, and (5) use every facility in aiding farmers to produce to the maximum with restricted labor and materials.

The Problem and its Significance: About one-fifth of the land area of the United States lies in semi-arid regions where light rainfall is the major factor limiting crop production. Except in a few scattered irrigated areas within this vast region, crops are produced successfully only by cultural methods that store rainfall in the soil and promote its efficient use by plants. Farm practices, therefore, must be carefully adapted to an erratic climate and to varied soil conditions. Not only the cultural methods but also the crops must be peculiarly adapted to such conditions in order to insure a stable agriculture.

In the Great Plains alone, dry farming is practiced on nearly half a million farms aggregating 107,000,000 acres of crop land. These farms comprise over half of America's total wheat acreage, three-fourths of the hard-red winter and spring wheat acreage, and large parts of the acreage devoted to flax, barley, oats, rye, corn, and cotton production. On many of these farms, pioneering practices have given way, or are giving way, to more mature practices, based upon the results of experience and experiment during the last forty or more years. With better information as to the true possibilities of soil and climate there is now developing a pattern upon which to base a permanent successful agriculture for the area. Better understanding of the Plains environment, more widespread use of improved methods of soil management to store water, control erosion, and meet crop requirements, adjustments in cropping methods, and the use of improved varieties to meet drought, disease, insect and other hazards--all these factors are discernible in the progressive improvement of agriculture in the Great Plains and other semi-arid regions.

There is a generally recognized need for additional factual information on cropping methods, crop rotations, grass establishment and utilization, home gardens, windbreaks, and general land-use adjustments to maintain present trends toward improved dry-land agriculture. This is particularly true in view of the task farmers now confront in meeting the problems resultant from earlier land policies that were conducive to exploitation, misuse, confusing ownership patterns, and inequitable taxation; as well as the more recent consequences of wartime disturbances affecting all phases of agricultural activity.

Since its beginning the work under this appropriation has been directed to the determination of best methods of utilizing the natural soil and climatic resources of the semi-arid and sub-humid areas of the country. Adjustments in work made to meet problems arising from the climatic and economic stresses of the past decade, when only the most efficient methods made survival and continuation possible, have in fact been so made that without major changes the now pressing war needs are being successfully met. The experimental results from the field stations are furnishing a background of fact of great value in guiding agricultural programs and fostering food and feed production at highest possible levels during the war, and in indicating readjustments that inevitably will follow the war.

General Plan: The investigations are conducted, generally in cooperation with the state experiment stations or with other agencies of the Department, at (1) field stations maintained by this Bureau at Akron, Colorado; Tucumcari, New Mexico; Mandan, North Dakota; Lawton and Woodward, Oklahoma; Big Spring and Dalhart, Texas; and Sheridan, Wyoming; (2) field stations maintained by the Bureau's Division of Irrigation Agriculture at Huntley, Montana, and Newell, South Dakota; and (3) State Substations at Colby, Garden City, and Hays, Kansas; Havre and Moccasin, Montana; North Platte, Nebraska; Dickinson, North Dakota; Pendleton and Moro, Oregon, and Archer, Wyoming. At these stations facilities are provided, not only for the research work of the Bureau's Division of Dry-Land Agriculture, but also for work which is cooperative with various other divisions of the Bureau, such as Cereal Crops and Diseases, Forage Crops and Diseases; with other agencies of the Department, such as the Soil Conservation Service; and with the state agricultural experiment stations of the several states. These stations provide the principal agricultural research facilities for this vast region of one-fifth of the United States.

Examples of Progress and Current Program: The 18 field stations in the Great Plains and one in the Intermountain Area, operated in cooperation with state experiment stations and Federal agencies, serve as centers for developing cropping and rotation systems for the dry-land areas, and, in cooperation with other divisions of the Bureau, for testing, breeding, and distributing new and improved crop varieties. These stations are also

foundation sources of pure seed. At the Kansas stations, cropping systems have been developed utilizing grain sorghums that will mature in this section of the High Plains. This work has provided farmers with a reliable feed-grain supply that is being used for increased production of sheep, beef cattle, dairy cows, hogs, and poultry.

Although many of the experiments on field stations are of long-time nature and have been continued, other phases of the work have been modified, shifts in emphasis have been made, and problems of immediate concern under stress of wartime needs have been given increased attention. Rotation experiments have been changed to include more feeds and roughages grown on the farm and to involve cultivated pastures that can supplement the native range. Cereal hays as concentrated feeds are under investigation. Seed of the best crop varieties is being increased and distributed to insure increased production.

Improvement of the range through control of sagebrush and other unpalatable plants is yielding striking results, and many stockmen are now adopting the demonstrated practices. Methods for reestablishing stands of grass on abandoned farm lands are being developed, and are providing a basis for the regressing of large acreages now being done by farmers. Seed of native grasses is being increased for distribution. Cooperative regressing experiments are demonstrating the grasses that form the most durable type of sod formations and that will be valuable for use on airfields, artillery ranges, and other military areas in semi-arid regions. At the Woodward, Oklahoma, station, equipment for the grass and pasture project has been installed, including fences, corrals, watering and weighing facilities, and cooperative pasturing experiments have been started. Grass plantings are being made to provide pure and mixed stands of various species for testing their suitability and relative grazing value under varying systems of pasture management.

The growing of combine-type sorghums is on the increase in many parts of the grain sorghum area, due to labor shortage that makes hand heading impractical. In cooperation with other divisions of the Bureau and with state experiment stations, disease resistant strains of this combine type are being developed at some of the field stations; seed stocks of these resistant strains are being increased and some of them are being distributed.

Methods by which the limited quantities of machine and manpower available can be used to effect the most economical crop production are being determined by cultural experiments. Emphasis is being given to crops that require less man-hours of labor per unit of yield. The general over-all purpose of the shifts has been to promote the most effective use of present supplies of labor and machines.

A positive wartime service is being rendered throughout the Great Plains by furnishing information based on dry-land possibilities of producing "war crops," such as peanuts, safflowers, and soybeans in the Southern Plains, and flax in the North. This information points out areas where increased production of one or more of these crops is desirable, and areas where any increase in production is almost certain to result in economic loss.

The stations are cooperating with Federal and other agencies in testing numerous plants that have oil, rubber, or chemical possibilities for replacement of products whose importation has been stopped, or for supplying essential needs. These include guayule, pyrethrum, sage, caraway, angelica, fennel, and Mormon tea; and several varieties each of artichokes, sunflower, castor beans, flax, safflower, coriander, rape, anise, chicory, cumin, mustard, peanuts, and milkweed. Russian dandelion (*Taraxicum kok-saghyz*), a possible source of rubber, is being grown on sufficient acreage at one station to furnish material for processing tests and to provide information on cultural practices. Barley and sorghums with waxy-endosperms are being increased for possible use as root starch substitutes. Variety tests of castor beans for oil are under way at several stations.

The importance to farm families in dry-land areas of a home-produced supply of vegetables and fruits is emphasized under wartime dislocations of production, processing, and distribution. Work conducted over several years at dry-land field stations has shown that the farm garden can be an important source of food even under the hazards of drought, cold, high wind, and other adverse climatic conditions, if shelter is provided and proper systems of cropping, tillage, moisture conservation, and fertilizing are used. With these practices must go a proper choice of varieties, many of which have been and are being developed to meet the special climatic conditions. Seed of four new varieties of tomatoes was distributed to co-operators in 90 counties in the Southern Great Plains this year. Hardy types of apples, plums, gooseberries, and currants developed by breeding and selection are being propagated for distribution.

Cooperative windbreak test plantings show that trees can be grown in the Plains to protect the farmstead, reduce fuel consumption, provide shelter for livestock, protect fruit and vegetable gardens from wind damage, and serve as snowtraps to deposit snowdrifts on garden and orchard areas, thus increasing their water supply. With the greatly increased demand for Victory gardens, the recognition of the need for protective windbreaks has become very apparent. Inspection of cooperative farm windbreaks to determine their growth and survival on different soils and in different locations has been suspended for the war period. The accumulated information on the behavior of various species of trees and shrubs in cooperative plantings over wide areas also is providing information on those that can best be used for planting in connection with military installations, such as air fields, munitions dumps, etc.

(f) FORAGE CROPS AND DISEASES

Appropriation Act, 1943	\$358,500
Budget estimate, 1944	<u>292,000</u>
Decrease (including decrease of \$1,130 travel funds returned to surplus)	<u>-66,500</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Forage crop production, breeding, disease, and quality investigations :	:	:	:	:
(a) Alfalfa	\$59,294	\$60,500	\$57,530	-\$2,970 (
(b) Clover	26,759	27,150	25,750	-1,400 (
(c) Soybeans	17,459	17,700	16,900	-800 (
(d) Lespedeza, cowpeas, and miscellaneous legumes	35,662	36,950	34,950	-2,000 (
(e) Hay and pasture grasses	153,516	157,570	149,370	-8,200 (
(f) Turf	7,500	57,500	7,500	-50,000 (
Covered into Treasury in ac- cordance with Public Law 674:	- -	1,130	- -	-1,130
Unobligated balance.....	5,940	- -	- -	- -
Total estimate or appropriation	306,130	358,500	292,000	-66,500

DECREASE

The decrease of \$66,500 in this item for 1944 consists of \$1,130 decrease in travel funds (returned to surplus in 1943) and the following decreases:

- (1) Alfalfa, \$2,970. This decrease contemplates discontinuing cooperative alfalfa investigations at Stoneville, Mississippi, and curtailment of cooperative alfalfa work with State Experiment Stations at Manhattan, Kansas; Lincoln, Nebraska; Reno, Nevada; and Logan, Utah.
- (2) Clover, \$1,400. This decrease contemplates curtailment of cooperative clover investigations with the Illinois Experiment Station at Urbana, Illinois.
- (3) Soybeans, \$800. This decrease contemplates curtailment in services at the Plant Industry Experiment Farm related to cooperative soybean investigations with several state experiment stations.

(4) Lespedeza, cowpeas, and miscellaneous legumes, \$2,000. This decrease contemplates curtailment of legume improvement work at Beltsville, Maryland; Experiment, Georgia; and Columbia, Missouri.

(5) Hay and pasture grasses, \$8,200. This contemplates curtailment in grass improvement work at Beltsville, Maryland; Raleigh, North Carolina; and Mandan, North Dakota.

(6) Turf, \$50,000. This decrease involves the special advisory services and investigations conducted in cooperation with the Army, Navy, other Federal agencies, and state experiment stations, on the establishment and maintenance of turf for military airfields and other war purposes, for which an increase of \$50,000 was provided in the fiscal year 1943. If the military services require continuation of this work in fiscal year 1944, it is planned to request that funds be transferred to cover the necessary costs.

The estimated distribution of the decrease under this appropriation by States is as follows:

Florida	\$350	Nebraska	2,920
Georgia	6,750	Nevada	150
Illinois	1,400	North Carolina	650
Kansas	1,083	North Dakota	1,500
Louisiana	250	Oklahoma	2,834
Maryland	35,351	Oregon	2,500
Mississippi	1,200	Rhode Island	1,583
Missouri	1,666	Utah	2,150
Montana	50	Washington	417
		Wisconsin	2,566
			65,370

WORK UNDER THIS APPROPRIATION

Objective: During the war emergency, special emphasis is being placed on those lines of work that offer the greatest contribution towards increased production of forage to meet wartime demands for meat, dairy products, and wool; for increased use of legumes to partially offset nitrogen shortages; and for increased production of soybeans and other critical crops. These research contributions are realized by (1) reducing losses from drought, disease, cold, heat, and other hazards; (2) increasing the yields of forage; (3) improving its value for livestock feed; and (4) promoting and facilitating a greater use of legumes for winter cover crops. The forage crop scientists are also rendering assistance in the establishment and maintenance of turf on military airports, cantonments, and other problem areas.

The Problem and its Significance: Grasses and legumes, the most important food and soil-conserving crops, are grown on more than 600 million acres in this country, or on about half of the total farm area of the United States. A conservative estimate of the total annual farm value of all forage crops would be upwards of \$1,500,000,000.

To meet the greatly increased demands for meat and dairy products and wool resulting from the war effort, it is essential to increase yields of forage crops through modification and improvement in cultural and management practices under existing shortages of labor, machinery, and fertilizer, and the development and use of better adapted varieties having greater resistance to cold, drought, and diseases.

General Plan: The work consists primarily of field and laboratory experiments in cooperation with state agricultural experiment stations, Federal agencies, farmers, various crop improvement associations, and other similar groups. Cooperative work is in progress in each of the 48 states, with full time employees located in 22 states. Results are made available to farmers through the state experiment stations and extension services and by publications. During the war emergency, emphasis is being placed on making available to farmers information on how to maintain production and at the same time modify practices so as to offset wartime shortages of fertilizers, labor, and equipment. Emphasis is likewise being placed on increasing as rapidly as possible the seed supplies of new, improved types of forage crops for use during the emergency. Special efforts are being made to assist in establishing and maintaining turf for camouflage and intensive use on military airports, cantonments, and other problem areas.

Examples of Progress and Current Program:

Alfalfa investigations: Increased demands for alfalfa to produce hay, pasture, or silage as feed for beef cattle and dairy herds has also increased the demand for seed of adapted varieties to meet not only our own needs but those of our Allies and of neutral nations unable to produce seed successfully or to obtain adapted seed from other sources. The research program is producing information on the relation of cultural practices to seed setting and the presence or absence of beneficial and injurious insects, information that may make alfalfa seed production more dependable.

Emphasis is being placed on making available to farmers information on cultural practices, stage of cutting, methods of curing and storing necessary to increase the yield and feeding value of the hay.

Bacterial wilt is the most serious and widespread disease attacking alfalfa. This disease reduces yield, the life of the stand, and the nutritive value of the forage. Growing alfalfas resistant to the disease is the only satisfactory control. As reported last year, a new alfalfa,

A-136, resistant to bacterial wilt, is being increased. It is planned to push the increase of this seed as rapidly as possible for commercial use in those areas where wilt occurs. About 14,000 pounds of seed produced in 1942 is being released. Attempts are being made to develop strains combining resistance to bacterial wilt with resistance to other diseases and desirable in other respects. Major emphasis is being placed on seed production and on rapid testing and increase of these alfalfas, because of the relation of high quality forage to war production goals.

Clover investigations: Clover is also playing an important role in supplying hay and pasture for the increased dairy and livestock production program. Throughout the Corn Belt, clovers are the most widely used legumes for soil improvement. With the short nitrogen supply, and the war need for increased food and feed crops, the clovers are of vital importance in maintaining soil productivity. Lend-Lease requirements for seed of red, alsike, and white clovers amount to over 6,000,000 pounds in 1942. Increased seed production, particularly of Cumberland and Midland varieties of red clover for the Corn Belt and Eastern States, and of the new superior varieties of all clovers, is being stressed. Important new varieties of sweet clovers include Madrid, a superior biennial yellow for the Great Plains; Spanish, a high yielding biennial white; and Evergreen, a late type. The studies with these new strains involve the determination of regions where best adapted; methods of producing the most seed possible per unit area; and the protection of seed stocks to avoid deterioration of productive capacity because of contamination with inferior strains.

Soybean investigations: The soybean has become especially valuable during the present national emergency, not only for oil, but because of its ready convertibility into many highly nutritive foods and because the oil meal can be utilized by manufacturers of other valuable and essential products. Soybean flour and other soybean products, of high nutritive value, are being used in many of our army camps and are being sent to England under the Lend-Lease Act. In our present national stress the importance of the soybean is clearly indicated by the record acreage and production goal set for 1942, which reflects the acute fat and oil situation.

The production of seed for commercial purposes is a well-established industry, especially in the Corn Belt, increasing from 5 million bushels in 1925 to over 200 million bushels in 1941. In cooperation with state experiment stations and other agencies several high seed yielding, yellow-seeded varieties have been released in areas where there has been an acute need of varieties for industrial purposes. Forty-five vegetable varieties ranging from 75 to 170 days in maturity, have been named and released.

In cooperation with the Special Research Fund Regional Soybean Laboratory the work is pointed toward the development of varieties with high oil and protein content and quality, high seed yield, and disease resistance, and the rapid increase of such types for use during the emergency. Boone, Patoka, and Gibson, high oil and high seed yielding industrial types of soybeans for the southern part of the Corn Belt, and an early industrial type not yet named, are being released. The great increase of soybean acreage during the past two years has emphasized the importance of leafspot, pod, and stem diseases of soybeans. Methods of control and the development of strains highly resistant or immune to these diseases are needed, and work is in progress on these problems.

Lespedeza, cowpea, and miscellaneous legume investigations: These legumes occupy a very important place in the agriculture of the United States, particularly in the South. In the present war emergency they are sources of highly nutritious forages demanded by the increased goals for meat and dairy products to supply our Army and Navy and our Allies. Lespedeza is a particularly valuable pasture plant and it is generally agreed that meat and dairy products can be most economically produced on pasture.

The present emergency has created a serious shortage in nitrogen fertilizers which are essential to satisfactory yields of corn, cotton, small grains, and many other crops on soils of low fertility. The serious effects of such nitrogen shortages can be offset in part by plowing under leguminous crops. Lespedezas and Crotalarias are important summer legumes for use in controlling erosion and for maintaining soil fertility, while vetches, bur clover, and field peas are winter crops used for similar purposes. The increased use of these crops as green manures has stimulated seed requirements particularly of vetches and field peas, and the Bureau of Plant Industry has cooperated with other Federal and state agencies in encouraging increased production of seed to meet these demands.

Progress is being made on the development of more productive types of annual lespedeza for the South, and more cold resistant types to permit extension of the area of successful production northward. Attempts are being made to develop a strain of lespedeza sericea with low tannin content, that, if successful, will greatly extend the usefulness of this plant. Several improved strains of vetches are being increased for further testing. Diseases are of major concern in the production of field peas, and present breeding work shows promise of developing resistant strains.

Hay and pasture grass investigations: Grass is carrying the largest livestock population in the history of the Nation. The 125-billion-pounds milk goal is the highest ever attempted. Dairy and meat products are an essential part of the balanced nutritional program needed to fit

the American people for a supreme war effort. Maximum and efficient production will be essential to meet all requirements. Well-managed land under sod can be made to produce maximum yields with a minimum of labor to help balance the labor shortage during the war emergency.

Emphasis is being placed on improved seeding and establishment practices, fertilization, new management practices to protect and maintain productive stands, and to lengthen the pasture season and lower livestock production costs. Over a hundred new strains of our commonly grown grasses are now being intensively tested in all regions of the country. Several of the most promising strains of adapted grasses are being increased immediately for commercial use.

Turf investigations: The Appropriation Act for the fiscal year 1943 provided funds for turf investigations to determine the most practical means of establishing and maintaining suitable turf on military sites, including airfields, flight strips, and cantonments, and on commercial airports and highway shoulders. The need for satisfactory turf on air fields to control dust and mud is particularly urgent. The wear on cylinders caused by dust greatly reduces the efficiency of airplane motors. Turf also is highly important in controlling erosion on highway shoulders, and in controlling erosion, mud, and dust on cantonments.

Advisory services on turf were given by Department specialists on about 100 military airports in the summer and fall of 1942. Recommendations for procedures to obtain satisfactory results in the shortest possible time are based to a large extent upon previous work done with grasses and legumes for other uses. Experimental areas are also being established on military airports to test various means of establishing and maintaining turf under use. The program is being developed as rapidly as possible, in cooperation with all state and Federal agencies where facilities are available. Many experimental plantings, including different grasses, fertilizer treatments, and cutting practices have been established in cooperation with the State Agricultural Experiment Stations and the State Highway Departments in Connecticut and Wisconsin, and in cooperation with the Virginia State Highway Department. In cooperation with a State Experiment Station, tentative arrangements have been made with the Navy Department to assist them in establishing turf on an entire area, including flight strips and cover as camouflage on munition dumps. A heavy duty turf garden is being established at the Plant Industry Experiment Farm at Beltsville, Maryland. Stocks of grasses that appear to have most promise for use on air fields, flight strips, and roadsides are being increased for experimental and observational tests in different regions of the country.

(g) FOREST PATHOLOGY

Appropriation Act, 1943	\$258,460
Budget estimate, 1944	<u>244,100</u>
Decrease (including decrease of \$1,515 travel funds returned to surplus)	<u>-14,360</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase decrease
1. Diseases of pine and other coniferous forest trees and for- est products:				
(a) White pine blister rust in- vestigations	\$16,900	\$15,200	\$14,500	-\$700
(b) Ponderosa pine disease in- vestigations	11,900	8,040	8,040	- -
(c) Little leaf disease of southern pine	16,000	16,030	15,880	-150
(d) Southern pine diseases other than little leaf	9,200	10,100	10,000	-100
(e) Spruce, fir, cedar, and other conifer disease investi- gations	37,100	36,700	35,650	-1,050
(f) Coniferous forest product disease investigations	20,345	36,400	36,400	- -
Total, diseases of pine and other coniferous forest trees and forest products .	<u>111,445</u>	<u>122,470</u>	<u>120,470</u>	<u>-2,000</u>
2. Diseases of elm, chestnut, and: other broadleaf trees:				
(a) Dutch elm disease investi- gations	33,900	23,160	22,045	-1,115
(b) Elm diseases other than Dutch elm	11,585	12,600	11,000	-1,600
(c) Chestnut disease investiga- tions	15,400	15,200	14,570	-630
(d) London plane disease inves- tigations	5,400	5,400	4,200	-1,200
(e) Oak disease investigations	14,900	14,355	12,205	-2,150
(f) Birch, beech and maple dis- ease investigations	22,400	21,800	19,900	-1,900
(g) Poplar, hickory, persimmon and other broadleaf disease investigations	29,900	32,600	32,300	-300
(h) Cactus disease investiga- tions	10,000	9,360	7,410	-1,950
Total, diseases of elm, chest- nut, and other broadleaf trees	<u>143,485</u>	<u>134,475</u>	<u>123,630</u>	<u>-10,845</u>

PROJECT STATEMENT - Continued

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
Covered into Treasury in accordance with Public Law 674	- -	1,515	- -	-1,515
Unobligated balance.....	1,905	- -	- -	- -
Total estimate or appropriation	256,835	258,460	244,100	-14,360

DECREASE

The decrease of \$14,360 in this item for 1944 consists of \$1,515 decrease in travel funds (returned to surplus in 1943) and a decrease of \$12,845, as follows

(1) Diseases of pine and other coniferous forest trees and forest products, \$2,000. This decrease is estimated by work projects as shown in the project statement, and contemplates curtailment of work in California, Connecticut, and Ohio, and at Beltsville, Maryland.

(2) Diseases of elm, chestnut, and other broadleaf trees, \$10,845. This decrease is estimated by work projects as shown in the project statement, and contemplates curtailment of Dutch elm disease investigations at Morristown, New Jersey; investigations of elm diseases other than Dutch elm at Morristown, New Jersey, and Columbus, Ohio; investigations of chestnut blight, and diseases of London plane, birch, beech, maple and other hardwoods in California, Connecticut, Florida, Maryland, North Carolina, and Ohio; cactus disease investigations in Arizona; and curtailment of work at Beltsville, Maryland.

The estimated distribution of the decrease by States is as follows:

Arizona	\$1,950	Maryland	\$4,095
California	700	New Jersey	2,900
Connecticut	1,500	North Carolina	600
Florida	300	Ohio	800
			12,845

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of the work in forest pathology is to increase returns from tree and timber production and to enhance the value of the products by reducing the occurrence of diseases and the damage they cause. This includes such currently important aims as preserving tree values for camouflage and preventing losses in wood used for military purposes. Immediate

objects include (1) developing ways for managing forests and handling the products so as to prevent disease losses, (2) devising methods of selecting trees and wood so as to avoid disease-damaged material, and (3) developing improved practices in maintaining the wood in buildings, ships, airplanes and other uses. Underlying all these objectives is the purpose of determining the nature and causes of tree diseases.

The Problem and its Significance: Diseases cause more damage to forests than fires do. Heart rots alone make it necessary to cull more than an eighth of the gross volume of the annual saw-timber cut. Yet diseases not only do damage to the wood but also cause a needless loss of time and effort when the effects are not noted before cutting. Thus it is important not only to control disease but also to learn how to recognize in advance the damage that has already been done. Recent trends in forestry intensify these needs. Selective logging methods, now being widely adopted, are likely to increase decay hazards unless this is especially guarded against. Improvement operations in second growth stands may fail if disease aspects are neglected. The extensive forest and erosion-control plantings are hampered by losses from disease. Disease epidemics destroy shade and ornamental trees, leave city streets without trees, and reduce property values. Much of the lumber now being sold is from second growth and has a high proportion of sapwood, which renders it more resistant to decay than the lumber formerly available. Greatly increased use of wood in aircraft and boats and the scarcity of standard protective fungicide materials raise many new problems. The Navy requires a large increase in production of turpentine, which necessitates the development of safe methods for stimulating pitch flow and for controlling diseases that affect the freshly cut faces of trees.

General Plan: This work is directed almost wholly to the solution of current disease problems in connection with forestry, wood utilization, and shade-culture. Laboratory and controlled-field tests are conducted in cooperation with the Forest Service, the Soil Conservation Service, the National Park Service, State Experiment Stations, municipalities, and nurserymen.

Examples of Progress and Current Program:

Prevention of decay hazards in aircraft, ships, and war housing: Sitka spruce is a principal source of airplane wood. Because of heavy drains on the Oregon-Washington supply, a pathologist has been sent to help the Forest Service select timber free from decay for rafting from Alaska to Seattle. Laboratory tests to improve methods used by aircraft inspectors in detecting incipient infections are being extended to Douglas fir, noble fir, and western hemlock, which are being employed to supplement the spruce. The purpose is to facilitate the discard of unsafe and the saving of safe material.

Accelerated decay tests have been set up to get information on wood deterioration around metal fastenings, both in airplanes and in wooden ships, and search is being made for methods of avoiding this deterioration. The decay of pine, fir, and oak in wooden boats such as minesweepers and submarine chasers, is being studied. Preliminary results have been made available to the Navy. A study has been started on the effect of fire-retarding chemicals on the susceptibility of wood to decay.

Studies are being made of building rots with special reference to the amount of ventilation needed below the floors in basementless cantonment and war-housing buildings. Most of these buildings are being rapidly constructed of lumber from younger trees containing more sapwood, increasing the susceptibility to decay. In collaboration with the Bureau of Entomology and Plant Quarantine, a mimeographed report has been issued on what is needed to safeguard new construction against decay and insects and to maintain buildings already erected. This report has been in large demand by agencies engaged in war housing.

Reducing decay losses in wood for paper pulp and tannin: Recent work on heart rots of balsam fir has shown that trees less than 80 years old can be cut with a larger production of sound wood than is realized when cutting is postponed until the trees are older, as in the longer rotations. These findings will facilitate pulpwood production. Tests of methods of handling and curing hemlock bark and oak tan bark are being made to decrease the losses from decay in the tannin industry, now being pressed by the demand for heavy leathers for military uses.

White pine blister rust: In California the forest pathologists are helping in an extensive program for controlling blister rust on sugar pines. As a basis for control measures they are noting the distance between sugar pines and the different species of ribes from which the blister rust infection comes and finding out how the rate of infection and tree destruction is affected by the distance between the two hosts of this disease. The results will guide the Forest Service in its management of the sugar pine stands that are being extensively cut for use in war-production operations. In both the East and the West individual white pines that show resistance to rust are being propagated and tested to obtain resistant types for future plantings. Development of trees that will resist this disease is particularly important in areas where it is not practical to get protection from the rust by eradicating the ribes.

Little-leaf disease and fusiform rust in the South: Work is being pushed on the cause and control of the little-leaf disease which is alarming in its capacity to reduce the stand of the already insufficiently available southern pines. Immediate information on the nature and progress of this disease is needed for guidance of the present heavy-cutting program, particularly for the short-leaf pine areas of Alabama and the Carolinas. Damage from fusiform rust also is increasing in the southern pine region, and methods of decreasing this hazard are being sought.

Turpentine production: A pathologist is assisting the Forest Service in its development of chemical methods of stimulating resin flow from turpented pines to increase production of naval stores needed for the war effort. The response of the resin-producing tissues to chemicals applied to the chipped surfaces, or "streaks", is being studied to provide advance information on the safety of the treatments used.

Disease defects in plywood for planes and boats: The birches, yellow poplar, maple, and sweet gum are the native hardwoods most used for aircraft plywood. In all of them discolorations of unknown cause and importance are giving concern to plywood manufacturers. A study is being made of these discolorations to determine which are harmless and which indicate infections that cause structural weakness. There is difficulty in getting sufficient plywood of aircraft grade. The results of this study already published make possible a 20 per cent increase in the yield of yellow poplar for gliders.

Accelerated decay tests are being conducted on plywood made from veneers of different thickness and with different kinds of glue, to gain information regarding their decay resistance in plane and boat construction. Surveys of older civilian airplanes at repair shops and airports are being made to determine the decay hazards from infections in service and whether these are great enough to necessitate changes in design or to warrant the use of wood preservatives. Findings to date indicate satisfactory conditions in planes of modern design that are kept under cover, but further study is being made for outdoor storage and tropical conditions typical of military use.

Dutch elm disease and phloem necrosis of elm: To get American elm trees that are resistant to phloem necrosis and Dutch elm disease, seeds have been gathered from various types of trees and from various regions. The resulting trees are being grown in the Dutch elm disease area near New York City and the phloem necrosis area around Columbus, Ohio. Resistance is being determined by inoculating the trees with the Dutch elm fungus and phloem necrosis virus. Some of the elms under test have shown definite resistance to Dutch elm disease in the elimination trials. The survivors will be carefully preserved and propagated. Crosses have been made between various elm species, special use being made of *Ulmus pumila*, the Siberian elm which is resistant to these diseases. Chemical injection tests are being conducted to develop a method for preserving valuable individual trees. More than one hundred chemicals have been given preliminary tests, and the most promising ones are being tested further. In the Northeast it is important to preserve elms for camouflage purposes.

Saguaro cactus disease: Work to determine control methods for a virulent bacterial disease of giant cactus has been started in a selected tract in the Saguaro National Monument in Arizona. Tests are under way to determine the cactus species affected, the rate, time, and conditions of the disease's spread, and the value of sanitation measures and treatments for curing diseased plants. The general destruction of the giant cactus by this disease, not arrested, would not only ruin the National Monument, chief scenic feature of a large section of Arizona, but also would be a serious loss to the inhabitants of the desert country in the Southwest where this plant furnishes food for the Papago Indians and protection for wildlife. The Indians preserve the plant's fruit and use it as an important reserve food supply in times of extended drought.

(h) FRUIT AND VEGETABLE CROPS AND DISEASES

Appropriation Act, 1943	\$1,444,439
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Office of Administrator, Agricultural Research Administration"	-6,000
"Salaries and expenses, Library"	-7,900
Total available, 1943	1,430,539
Budget estimate, 1944	1,356,840
Decrease (including decrease of \$2,290 travel funds returned to surplus)	-73,699

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Deciduous fruit investiga- tions	\$289,279	\$285,140	\$275,130	-\$10,010 (1)
2. Citrus, avocado, and other subtropical fruit investiga- tions	105,916	113,570	102,800	-10,770 (2)
3. Nut investigations	239,472	230,950	218,540	-12,410 (3)
4. Vegetable investigations ...	281,150	301,170	287,720	-13,450 (4)
5. Investigations of plants for landscaping and ornamental purposes	77,837	68,180	62,280	-5,900 (5)
6. Nursery stock and farm wind- break investigations	64,785	59,389	53,910	-5,479 (6)
7. Potato investigations	97,977	103,460	100,350	-3,110 (7)
8. Methods of handling, trans- portation and storage, and market diseases of fruits, vegetables, and flowers	172,674	191,490	185,650	-5,840 (8)
9. Greenhouse experiments	76,437	74,900	70,460	-4,440 (9)
Covered into Treasury in ac- cordance with Public Law 674	- -	2,290	- -	-2,290
Unobligated balance.....	33,300	- -	- -	- -
Total estimate, 1944, and comparable amounts, 1943 and 1942	1,438,827	1,430,539	1,356,840	-73,699

DECREASE

The decrease of \$73,699 in this item for 1944 consists of \$2,290 decrease in travel funds (returned to surplus in 1943) and a decrease of \$71,409, as follows:

(1) Deciduous fruit investigations, \$10,010. This decrease contemplates curtailment of investigations on the production of high quality fruits and on spraying of fruits for the control of fungus and bacterial diseases at Beltsville, Maryland; on the response of pear trees to differential irrigation at Medford, Oregon; and on production of hardy fruits adapted to the Plains area, conducted at Cheyenne, Wyoming.

(2) Citrus, avocado, and other subtropical fruit investigations, \$10,770. This decrease contemplates curtailment of work on improving citrus varieties and on factors affecting the production of citrus fruits at Riverside, California; and on the development and testing of hardy root stocks for citrus and other subtropical fruits at Orlando, Florida; and curtailment in services at Beltsville, Maryland.

(3) Nut investigations, \$12,410. This decrease contemplates curtailment in investigations on pecan production, diseases, soil management, and fertilizer requirements at Yuma, Arizona; Albany, Georgia; Shreveport, Louisiana; and Brownwood, Texas; and curtailment in services at Beltsville, Maryland.

(4) Vegetable investigations, \$13,450. This decrease contemplates curtailment of work on improvement of sweetpotatoes at Baton Rouge, Louisiana; on the development of disease resistant varieties of cantaloupes and lettuce at Torrey Pines, California; on adaptability of vegetable varieties to the Great Plains area and the development of improved types at Cheyenne, Wyoming; and curtailment in work and services at Beltsville, Maryland.

(5) Investigations of plants for landscaping and ornamental purposes, \$5,900. This decrease contemplates curtailment of work on the development of American sources for bulbs, and on improvement and disease investigations of lilies, chrysanthemums, flowering bulbs, and related work at Beltsville, Maryland, and at Cheyenne, Wyoming.

(6) Nursery stock and farm windbreak investigations, \$5,479. This decrease contemplates curtailment of work on adaptability of various root stocks for apples, peaches, and other tree fruits at Beltsville, Maryland, and on farm windbreak investigations at Cheyenne, Wyoming.

(7) Potato investigations, \$5,110. This decrease contemplates curtailment potato improvement investigations at Beltsville, Maryland.

(8) Methods of handling, transportation and storage, and market diseases of fruits, vegetables, and flowers, \$5,840. This decrease contemplates reduction of work on cause and control of citrus diseases during packing operations while in transit and on the market conducted at Orlando, Florida; on citrus transportation and storage at Pomona, California; and on storage and market diseases of fruits at Beltsville, Maryland.

(9) Greenhouse experiments, \$4,440. This decrease contemplates a reduction in labor and other operating expenses for greenhouses at Beltsville, Maryland.

The estimated distribution of the decrease by States is as follows:

Arizona	\$500	Maryland	35,561
California	10,480	Oregon	400
Florida	6,600	Texas	2,000
Georgia	4,988	Wyoming	<u>5,980</u>
Louisiana	4,900		
			71,409

WORK UNDER THIS APPROPRIATION

Objective: To insure as nearly as possible adequate wartime supplies of essential fruit, vegetable, potato, and nut crops through (1) determining most economical methods of soil management, fertilizing, irrigating, pruning and harvesting to insure maximum production with minimum use of labor and strategic materials, (2) developing and disseminating information on diseases causing serious losses, and on how they can be controlled with existing materials, (3) devising methods of packing, shipping and storing to reduce losses and to economize in packaging materials and transportation equipment, (4) developing and making available as rapidly as possible varieties resistant to diseases and thus requiring less spraying, that are suitable for various uses including dehydration, (5) acting in an advisory capacity to war agencies relative to allocations of strategic fertilizers and spray and seed treatment materials, to securing supplies of vegetable seeds, and on methods of heavier car loading to conserve transportation equipment.

The Problem and its Significance: These crops are the great health protectors in human diet as well as highly important staple food sources. The farm value is indicated in the following tabulations:

	<u>Farm Value 1940</u>
*Fruit crops	\$ 398,500,000
*Truck crops including dry beans and peas	435,100,000
*Potatoes	257,900,000
*Nut crops	21,800,000
**Horticultural specialties, including nursery products, and flowers, bulbs, and plants grown in the open and under glass	129,500,000

* Figures taken or compiled from Agricultural Statistics, 1941

** From 1939 Census

Any material reduction in the quality or quantity of these crops as a result of disease epidemics, faulty handling, unfavorable climatic conditions or other causes would be extremely serious, not only to the farmers producing them, but particularly to the health and welfare of the civilian population and armed forces.

General Plan: The work consists primarily of field and laboratory experiments largely cooperative with state agricultural experiment stations, other Federal agencies, and producers of horticultural crops. National headquarters are the Bureau of Plant Industry Stations, Beltsville, Maryland, from which positive direction is given to work located in the States of Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, New Jersey, New York, North Carolina, Oregon, South Carolina, Texas, Utah, Washington, Wisconsin, and Wyoming. Many new problems are constantly arising in the present emergency due to shortages of fertilizers and materials for spraying and seed treatment, modified packaging and car loading, which can be met only by a continuing aggressive research program and the immediate release of information on the results obtained.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation or recent modifications of programs are cited to show progress in one or more aspects of the broader problems being confronted. They are illustrations of the ways in which the problems are being attacked and examples of results secured. No attempt is made to give a complete summary of the several hundred investigations that are under way.

Deciduous fruit investigations:

Economical use of nitrogen fertilizer on apples. Apples are the most widely grown important fruit crop in the United States. Nitrogen is the most important fertilizer element required by apple trees and large quantities of mineral nitrogen are applied annually. At the present time total supplies of mineral nitrogen for agricultural use are limited and methods of application that will give the maximum return for the amount applied must be used. Investigations conducted during the past several years have given much information on this subject. Investigations show that the nitrogen content of leaves may be used as an index of the adequacy of the supply of nitrogen to the trees. Nitrogen applied in the fall is absorbed by apple roots during winter and is transported to developing buds and shoots in the spring for their early growth. Grass roots apparently absorb nitrogen very slowly or not at all in the colder months. Thus the best time to apply readily available nitrogen to apple trees growing in sod in many locations is in the fall when the grass does not compete with the trees for the nitrogen.

New spray materials. Effective control of fungus and bacterial diseases is basic to stable and economical production of deciduous fruit as well as of important vegetable crops. Copper sprays have long been dependent upon for control of many fungus diseases of orchard, garden, and ornamental crops. These sprays, while effective in controlling the diseases, frequently cause injury to the plants, and under war conditions the supply of copper is limited. In recent years studies have been conducted on the use of some organic chemical materials as milder fungicides.

It has been discovered that certain organic compounds (the lead and iron salts of dimethyl dithiocarbamic acid) have promising fungicidal properties. In orchard spraying experiments these two compounds have given excellent results in the control of such destructive diseases as apple scab without causing

injury to the sprayed trees. These materials are outstanding as possible successors to the sulphur and copper sprays now in use.

Copper phosphate, another product of these studies patented by the Department of Agriculture, has continued to prove effective in the control of some diseases, such as cherry leaf spot, and canker rot on pears in storage. It is a safer fungicide since the copper is less soluble in this form and, therefore, less injurious than the more common copper fungicide, bordeaux mixture. For economic reasons it is desirable to hold Anjou pears in storage until comparatively late in the season. In 1941 an application of 38,000 gallons of copper phosphate was applied to Anjou pear orchards to test effects in controlling storage diseases. Sprayed fruit taken out of storage has been shipped from the Northwest during the storage season with practically no rotting, while unsprayed fruits showed considerable amounts of canker decay.

New high quality peach varieties. As a result of peach breeding investigations under way in California for a number of years, four new canning cling varieties were introduced during the past year. Two of these varieties, named Fortuna and Shasta, are early maturing. One variety called Andora is midseason, while the fourth, Tudor, is late. These new peaches, with others introduced in previous years, give a succession of early to late ripening varieties that will provide for better distribution of seasonal labor for harvesting and canning.

In the eastern United States a number of early ripening peach selections have been made which appear to be superior to present day early varieties. These are being tested further to determine their commercial suitability and adaptation to regions with severe winters.

Because of the long-time nature of fruit breeding work these investigations are being curtailed during the war period, but existing breeding material is being maintained and evaluated to prevent serious loss of work already done.

Citrus and other subtropical fruit investigations:

Citrus fertilizer requirements. One of the most important factors affecting quantity and quality of citrus production is the fertilization program in the orchards. One part of a study of fertilizer requirements on citrus in Florida has been completed. Potash deficiency in oranges results in a decrease in vitamin C in the fruit and an increased concentration of sugar and in earlier maturity. When sufficient potash is added to correct the deficiency no improvement in quality or quantity of fruit was obtained from heavier applications. Muriate of potash available from American sources has been found to be as effective a source of potash as the more expensive imported sulphate of potash.

Prevention of date cracking. Serious losses occur in many seasons in date orchards due to a checking or cracking of the fruit in midsummer, which later results in a condition known as blacknose, or the blackening of the fruit resulting in almost complete loss. This has been found to be due to periods of high humidity accompanied by abundant moisture in the soil. Fruit is most susceptible in late July and August. By reducing the moisture content in the

orchard soils at that season, checking or blacknose can be greatly reduced. This practice is being adopted in orchards where this trouble has been seen.

Nut investigations:

Fertilizer requirements of tung trees. The growing of tung nuts for oil production is a new industry in this country. It has expanded very rapidly so that approximately 200,000 acres are now planted to tung trees. This acreage is mainly in the area within 150 miles of the Gulf of Mexico. Production under war conditions is being stimulated by all possible means.

The soils of Mississippi and Louisiana on which tung is grown have been found to contain practically no available phosphorus with the result that tung trees make very little growth unless this element is supplied. Furthermore, in these soils phosphorus applied in commercial fertilizer does not become readily available to tung trees. It has been found that, by fertilizing the winter legume cover crops heavily with available phosphorus, the cover crop is able to take up this element before it has been fixed by the soil. As a result, greatly increased yields of green manure are produced, and when turned under and decomposed, the tung trees are able to absorb the phosphorus released.

In portions of Georgia and Florida the soils have been found to be so deficient in potassium as to limit the growth and fruiting of tung trees, even though fertilized with 300 pounds per acre of 4-8-4 fertilizer. These findings substantiate those obtained in sand cultures which show that the tung tree has a very high potassium requirement. Mulches of organic materials such as clover, alfalfa, vetch, or even weeds, or the application of potassium nitrate, have been found to be the best means of providing potassium which is readily available to the trees.

Vegetable investigations:

Vegetable seed production. Because of the tremendous increase in vegetable seed requirements due to elimination of imports and the necessity of supplying large quantities of seeds to our Allies, it is necessary that commercial seed production be greatly expanded in the United States. The problems are particularly acute with biennial seed requiring two seasons for its development, such as carrots, onions, cabbage, and similar plants. In addition to cooperation with the Agricultural Marketing Administration on inspection of seed fields being grown under Lend-Lease, extensive work to determine additional areas where seeds may be grown and best methods of producing them was undertaken in 1942. Methods of disease control in vegetables being grown for seed, and determination of climatic and soil conditions essential for seed production are receiving special attention. This work is under way in the States of Oregon, Idaho, Utah, Wyoming, and Colorado, and some work has been developed in other states.

Vegetable seed storage. As a result of research extending over the past several years, the most satisfactory methods of storage of vegetable seeds, including particularly the effect of temperature and humidity on seed germination, have been largely completed. This information is of immediate importance under

present conditions when total seed supplies of some vegetables are insufficient to meet requirements and loss of seed in storage would be particularly disastrous. While individual seeds vary in their reaction to temperature and humidity, for relatively long storage temperature below 50 and preferably near freezing and a relative humidity in the atmosphere of not over 50 percent are essential. High humidity at any temperature leads to rapid deterioration of seed, the deterioration being more rapid the higher the temperature. Information on the exact effects of temperature and humidity on seed longevity has been placed in the hands of the industry and should greatly reduce seed losses in storage.

Peanut investigation. The war production program has included an increase of about 150 percent in peanut acreage. In the past, low yields have often made peanut plantings unprofitable. Previous work of the Bureau has developed high yielding strains of certain types of peanuts, and work is in progress to test the productiveness of a large number of imported types and selected strains of varieties grown in this country. Preliminary tests have indicated that dusting with sulphur will substantially increase yields of peanuts through control of leaf spots commonly present. The average increase has amounted to about 30 percent. The research program on peanuts in the southeastern states has been expanded through curtailment of other investigations less essential to the war program.

Improvement in vegetable crops. A long-time research program on the improvement in vegetable crops through developing varieties that are more disease resistant or better adapted to the climatic conditions prevailing in various parts of the United States is being conducted although on a somewhat reduced scale due to shortage of investigators and the necessity of giving special attention to acute problems resulting from the war. During the past year two varieties of head lettuce better adapted to the northeastern United States have been released to the trade. One of these named Great Lakes has been introduced in cooperation with the Michigan Experiment Station, and the other, Imperial 576, has been introduced in cooperation with the New York (Cornell University) Experiment Station. Both of these varieties appear to have superior merits for the heavily populated northeastern sections of the country, and their production would eliminate some of the long-distance haul of lettuce from the Pacific Coast for part of the year.

Three new varieties of snap beans adapted to the southeastern United States have been developed in cooperation with the U. S. Vegetable Breeding Laboratory at Charleston, South Carolina. Two of these named Cooper and Ashley are especially adapted to home and market garden culture in the South during the warmer seasons when other varieties are poorly productive, and are of particular importance now when home and local food supplies are so important. A third variety, Logan, is a superior quality, long Greenpod type of bean which also is particularly well adapted to summer production in the South.

Dehydration of vegetables and fruits. Shortage of containers and limitations of shipping space require greatly increased use of dehydration for preserving vegetables. Varieties differ much in their suitability for dehydration.

Investigations are in progress to determine the suitability of important varieties of sweet corn, carrots, sweetpotatoes, onions, potatoes, peaches and apples for dehydration.

Investigations of plants for landscaping and ornamental purposes, and greenhouse experiments:

American Easter lily bulbs. New varieties of Easter lilies have been produced which show promise of supplying a new horticultural crop for the southeastern states. Formerly about 26,000,000 Easter lilies have been imported into the United States each year for forcing by florists, about 95 percent coming from Japan. Many of the new stocks developed as a result of the breeding work carried on by this Bureau in many cases are superior to the imported stocks.

Under war emergency conditions the breeding work on all bulbs is being curtailed and facilities are being used largely in investigations on the production of seedstocks of vegetables and the propagation and testing of emergency war crops, such as guayule, Hevea, drug plants, and castor beans for oil, in cooperation with other units of the Bureau.

Nursery stock and farm windbreak investigations:

Rootstocks for fruit trees. Due to cutting off importations of French crab seed as a source of apple stocks, nurserymen in this country must turn to seedlings of commercial apple varieties for use as understocks. In studies on the suitability of a number of apple varieties for use as nursery seedling stocks a very high germination and yield in No. 1 seedlings were obtained from Rome Beauty, Winesap, and York Imperial. These varieties are extensively used in apple fruit processing and seed is readily available in any required quantity. The long-time orchard testing of performance of rootstocks for tree fruits is being kept on a bare maintenance basis during the war emergency.

Potato investigations:

Handling and transportation of new potatoes. Continuing investigations begun last year, work was conducted in Florida, Alabama, Mississippi, North Carolina, Virginia, Maryland, Nebraska, Colorado and California. Most of these new potatoes in these areas are washed, and packaged while wet. Because they are immature, the skin slips easily, and they are often badly "feathered" or skinned during digging and handling. These skinned areas are left unprotected and soon become sunken and blackened as the tissues dry out. It was found that if the potatoes can be kept in a cool, moist atmosphere the skinned areas will heal over and will not discolor or decay. In commercial scale tests with many carloads of potatoes, it was demonstrated that shipping under ventilation increases the drying-out injury and decay, whereas shipping under refrigeration prevents or minimizes losses from these causes. As a result, the new potato industry, particularly in Nebraska and Colorado, has practically abandoned the use of ventilation service in shipping to distant markets, and during 1942 used refrigeration almost entirely. This was true also to a more limited extent in early potato shipping sections along the Atlantic Seaboard, particularly in northern Florida.

Methods of handling, transportation and storage, and market diseases of fruits, vegetables, and flowers, Investigations of:

Heavy loading of refrigerator cars. War conditions have created a critical congestion of traffic on the railroads and make it essential to utilize refrigerator car space and motive power to maximum capacity and efficiency. General Order No. 18 of the Office of Defense Transportation, which became effective November 1, 1942, prescribes heavier minimum loads for many commodities. The specifications of this order as applied to fruits and vegetables are based in part on results of investigations along this line that have been in progress in this Division during the past two years. These investigations have shown how oranges can be transported satisfactorily from Florida and California to New York when loaded 50 percent heavier than was previously the custom. Similar results have been obtained with California lemons and Florida grapefruit. This was accomplished satisfactorily by proper precooling or shipment in cars equipped with fans to provide forced air circulation in transit. Similarly, methods of heavier loading have been developed for sweet cherries, melons, and other commodities shipped in rigid containers.

The heavier loading of products not packed in rigid containers, however, such as potatoes and onions in bags, has created a serious problem of protecting the bottom of the load from excessive bruising and consequent increased susceptibility to decay. Work on this is now in progress and will be followed by investigations of methods of protecting these shipments against freezing during the winter. Tests are being made with potatoes and onions shipped from Idaho to Chicago and New York.

New containers for fruits and vegetables. War conditions have created serious shortages of materials customarily used for shipping containers, particularly burlap for bags. At the present time serious concern is being felt over the possibility of a shortage of both lumber and steel for nails and wire necessary in their manufacture. Accordingly, investigations are being made of substitutes for critical materials - of cotton and paper bags in place of burlap, and of cotton bags and fibreboard boxes in place of wooden containers. It has been found that new potatoes can be shipped satisfactorily in multiwall paper bags of not more than 50 pounds capacity, but 100-pound bags containing washed potatoes (wet) did not carry satisfactorily in shipping tests from California to Texas and Chicago because of failure of the package. Of the various types of cotton bags tested a strong, rather open-mesh cloth proved more satisfactory than sheeting. It was found, however, that the cotton bags are less satisfactory in general than burlap because they become unsightly from dirt and fray or wear through more easily by friction where the bag is in contact with the floor or side of a car. Tests are being inaugurated on the use of cotton bags and fibreboard for containers of citrus fruit with particular reference to the increased minimum load requirements. Fibreboard containers for apples will also be tested.

(i) IRRIGATION AGRICULTURE

Appropriation Act, 1943	\$142,220
Budget estimate, 1944	<u>134,900</u>
Decrease (including decrease of \$220 travel funds returned to surplus)	<u><u>-7,320</u></u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Investigations of crop production on irrigable lands, the quality of irrigation water, and its use by crop plants:				
(a) Crop rotation and cultural in- vestigations under irrigation ...	\$83,268	\$84,350	\$80,980	-\$3,370
(b) Quality of irrigation and drainage waters	30,684	30,950	28,650	-2,300
(c) Water requirements of crop plants	24,714	26,700	25,270	-1,430
Covered into Treasury in accordance with Public Law 674	- -	220	- -	-220
Unobligated balance	2,534	- -	- -	- -
Total estimate or appropriation, ...	141,200	142,220	134,900	-7,320

DECREASE

The decrease of \$7,320 in this item for 1944 consists of \$220 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$7,100 estimated by projects as indicated in the project statement. This decrease contemplates curtailment in investigations to improve crop production under irrigation in Arizona, California, Montana, Nebraska, Nevada, Oregon and South Dakota; and in drainage investigations at Beltsville, Maryland.

The estimated distribution of the decrease by States is as follows:

Arizona	\$136	Nebraska	375
California	1,760	Nevada	2,300
Maryland	1,039	Oregon	740
Montana	375	South Dakota	<u>375</u>

7,100

WORK UNDER THIS APPROPRIATION

Objective: The broad objective of this work is to insure a successful irrigated agriculture in the United States, by determining (a) the best varieties of crops, crop rotations, and fertilization and irrigation practices; (b) the effects of salt constituents in irrigation and drainage waters and in the soil solution on the growth of crop plants; (c) the quantities of irrigation water required by different crops on different soils; and (d) the possibilities of increasing production of crops now urgently needed in the war effort.

The Problem and its Significance: The irrigated lands of the western United States comprise approximately 20 million acres. These lands occur in isolated areas contiguous to streams in the arid region. They are surrounded by extensive areas of semi-arid land used for dry farming, and for grazing. The agricultural enterprises of the irrigated lands and of the surrounding semi-arid lands are mutually interdependent, since the irrigated lands are sources of feed crops to supplement the ranges and, conversely, the use made of the forests and ranges directly affects the water supply for irrigation.

Because the operating expenses of irrigation farming are relatively high, involving service costs of irrigation water and the labor of applying it to the land, the crop yields must also be relatively large. Furthermore, the costs of the construction of works for the storage and distribution of irrigation water are so large that they must be liquidated over a long period. Permanency and sustained productivity of irrigated land are thus essential to economic success. The information already made available has contributed to a more stabilized agriculture throughout the arid and semi-arid West. Recent and further contemplated adjustments in the work are expected to yield information of greater usefulness in meeting current problems.

Approximately one-half of the total supply of irrigation water in the western United States contains so much dissolved salts as to be potentially injurious to the irrigated land unless adequate measures are taken to provide root zone leaching and subsoil drainage. Dissolved salts occur naturally in irrigation waters. Most of the salts obtained in the irrigation water are not absorbed by plants, but remain dissolved in the soil solution until removed by drainage. Drainage water from irrigated land is returned to the streams from which the irrigation water was diverted. Consequently, along streams to which diversions are made, the stream water becomes progressively more concentrated in the downstream direction. With the increased concentration of dissolved salts in the land, larger quantities of water must be used for root zone leaching in order to prevent salt concentrations harmful to plant growth.

In most irrigated areas much more exact information on the water requirements of various crops is necessary if the most economical use of water is to be realized. The quantity of water required by various crops varies widely under different soil and climatic conditions. Knowledge of the water requirement of different crops under given conditions constitutes a basis for minimizing water costs and maximizing the yield and quality of the crops produced.

General Plan: The work is done primarily at field stations supplemented by necessary laboratory experiments. The principal field stations are located on Federal reclamation projects. The facilities of these stations are used cooperatively for investigations by other divisions of the Bureau of Plant Industry, by the Bureaus of Animal and Dairy Industry, and by state experiment stations. The various state experiment stations are contributing financial support to the investigations. The free use of the land and of irrigation water has been provided by the Bureau of Reclamation, and this agency has also contributed some buildings and special aid in land leveling and ditch construction. The field stations are located at Huntley, Montana; Newell, South Dakota; Scottsbluff, Nebraska; Fallon, Nevada; Bard, California; and Hermiston, Oregon. Cooperative investigations are conducted also at a State Branch Experiment Station at Prosser, Washington.

Investigations on salt constituents of irrigation and drainage water involve cooperation with the Bureau of Reclamation, the Geological Survey, and the Office of Indian Affairs, all of the Department of the Interior, and corporate irrigation districts. These agencies collect samples of irrigation and drainage waters at appropriate gauging stations where the volume of discharge is regularly measured. These water samples with the discharge data are sent to the laboratory where the water is analyzed and the quantities of the salt constituent conveyed past each station are computed. Thus the annual input and output of dissolved salts (the annual salt balance) of an irrigated district is determined. If, at any district, the salt balance is adverse, that is, if the salt input exceeds the salt output, remedial measures are necessary.

Examples of Progress and Current Program: Principal emphasis is being placed on furnishing information of direct aid to farmers in irrigated areas in meeting war production goals. Information on cropping methods and crop utilization obtained from long-continued crop rotation experiments and findings as to the proper use of irrigation water are proving most useful at this time of labor and equipment shortages. This information is generally applicable to the approximately 20,000,000 acres of irrigated land in this country.

Because of war requirements the supplies of mineral fertilizers have been sharply curtailed. As a result of long continued investigations, significant information is being made available on how yields of war crops, such as long staple cotton and sugar beets, may be maintained and improved by means other than the use of these fertilizers.

In cooperation with other units of the Bureau, tests are being conducted on growing drug plants, castor beans, condiment plants, and guayule under irrigation. Tabulations of water and soil analyses in the Southwest are being used to determine needed improvements in drainage, contributing to the selection of areas for production of these crops.

Results have indicated desirable changes in irrigated crop rotations in the various areas, and these changes in the experimental rotations were initiated in 1942. Since, as noted above, under the relatively high costs of irrigated farming, profitable production is possible only with high yields, a continued

research program is essential to insure crop production under changing conditions resulting from long-time and more intensive use of irrigated lands.

In water requirement investigations of crop plants, preliminary results with cotton indicate that a modification of conventional irrigation practices, particularly with American-Egyptian types, may result in higher yields. Laboratory and spinning tests indicate that fiber structure and characteristics are influenced by irrigation treatments, and that higher spinning quality may be obtained by following proper irrigation practices.

In connection with a trend toward the use of year-round cover crops or grass sod in irrigated citrus and avocado orchards, data were obtained on relative consumption of water in mature Valencia orange and Eureka lemon orchards in permanent grass sod as compared with consumption in bare, uncultivated orchards. The sod growth increased water consumption by about 10 percent in the lemon orchard and 20 percent in the orange orchard, but the increases in water consumption are believed to be more than offset by advantages of the sod cover. Other aspects of citrus irrigation being studied include the effects of annual additions of organic matter and other materials on water penetration, soil structure, root development and tree response, and over-irrigation injury as related to soil types.

(j) NATIONAL ARBORETUM

Appropriation Act, 1943	\$54,892
Budget estimate, 1944	<u>38,000</u>
Decrease	<u>-16,892</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. National Arboretum - Development, maintenance, and operation of Arboretum	\$51,762	\$54,892	\$38,000	-\$16,892
Unobligated balance	2,900	- -	- -	- -
Total estimate or appropriation	54,662	54,892	38,000	-16,892

DECREASE

The decrease of \$16,892 in this item for 1944 will be effected by reducing labor and purchases of plant materials and other supplies, and a reduction in departmental salaries. Propagation of plants at the Arboretum will be discontinued,

for the most part, and work at the Arboretum will be on a maintenance basis with only such plantings made as are necessary to save plants now growing in the nurseries that must be transplanted or lost.

WORK UNDER THIS APPROPRIATION

Objective: The purpose of the work under this appropriation is to establish and maintain a National Arboretum with a diversity of tree and other plant life for research and educational uses, in conformity with the authorizing Act (Public No. 799-69th Congress).

The Problem and its Significance: The work at the National Arboretum has been and is now primarily on a maintenance basis. The planting work now contemplated is necessary to save plant materials propagated in the nurseries during recent years. These plants are increasing in size so that many of them must be transplanted each year or they will be lost. In order to obtain the largest possible amount of plant materials at lowest cost, there have been developed rather large nurseries grown principally from seeds and cuttings, together with some purchases and plants received through the facilities of the Bureau. The purchase of good-sized specimens of these various stocks would have greatly increased the cost of the Arboretum. This nursery material now covers an area of approximately 50 acres, and much of it has reached the point where it should be transplanted and cared for to prevent its loss.

Maintenance work is necessary in connection with drainage and erosion prevention, repairing and constructing fences, cutting of brush and weeds, and maintaining soil through cover cropping and fertilizing. Considerable planting has been done in the past on the 400 acres of the Arboretum, and it is necessary that these plantings be cultivated, kept free from weeds, fertilized, and in some cases watered. Unless this work is done, part of the material will die, and the investment put in to date will be lost.

The essential problem at the Arboretum is, of course, the development of the Arboretum into a living collection of all woody plants that can be grown in the District of Columbia, to serve as a source of plant materials and educational information concerning plant life for students and scientists throughout the country. With a great storehouse of plant materials from all corners of the world established at the Arboretum, breeders of trees, shrubs, and flowers will have an opportunity to cross native species with those from foreign lands for the development of improved strains adapted for special purposes such as for city parks, forests, boulevards, and streets. It is expected to make the facilities of the Arboretum available to scientists all over the world, and cooperation is contemplated with foresters, botanists, horticulturists, and other scientists in the improvement of trees, shrubs, and other plants. The Arboretum thus becomes an educational institution which at the same time will provide an abundance of growing plant material for scientific purposes. In order to be most useful for purposes of research and education, the Arboretum is being planned and developed with a view to taking the fullest possible advantage of all environmental factors at the

selected, such as soil type, slope, exposure, and drainage; (b) the grouping in the most suitable locations of all the adapted plants of many genera or species; (c) making them available for general observation and detailed study, and (d) preserving for reference, identification, and classification, herbarium specimens of all plant materials likely to be of value in this country.

General Plan: The National Arboretum is located in the District of Columbia, bounded approximately by M and R Streets, W. E., Bladensburg Road, and the Anacostia River. An advisory council, appointed by the Secretary of Agriculture in accordance with the Act of March 4, 1927 (20 U. S. C. 191-194), assists in planning the development of the Arboretum. Plant collections generally are established in nurseries at the Arboretum prior to being placed in permanent plantings. Plant materials are obtained by purchase, gift, and by transfer from our Division of Plant Exploration and Introduction, a source of exotic plants from foreign countries.

Examples of Progress and Current Program: Special service is being rendered in connection with the Department's Latin-American program, partly through use of the herbarium collection of the Arboretum, which includes 28,480 catalogued sheets from Latin American countries and about half as many more uncatalogued, and partly through service in botanical problems in cooperation with botanists in the Division of Plant Exploration and Introduction. Cooperation in the war effort also is being given in connection with the location of an Army unit at the Arboretum.

Approximately 9,000 plants (representing 105 different groups) were added to the nurseries of the Arboretum during the fiscal year 1942. Through available facilities of the Bureau, additional collections of plant materials were propagated for later transplanting to the Arboretum. It is contemplated that the Forest Service will begin soon to carry on forest tree breeding work at the Arboretum, formerly conducted in Massachusetts. Hybrid seeds will be grown at the Arboretum, which will furnish land for nursery and tree planting.

Continued maintenance and care are being given both to permanent plantings and nurseries at the Arboretum. A permanent planting of species of maple has been completed insofar as materials are now available, and permanent planting of various species of azalea is under way. Detailed studies are being made of Arboretum areas in connection with the establishment of specialized plant collections, and the development of landscaping features. During the past year, work on the physical development of the Arboretum has included road surfacing, stone riprap, retaining walls, grading, extension of water system, and a small greenhouse.

(k) PLANT EXPLORATION, INTRODUCTION, AND SURVEYS

Appropriation Act, 1943	\$301,403
Budget estimate, 1944	<u>286,160</u>
Decrease (including decrease of \$180 travel funds returned to surplus)	<u><u>-15,243</u></u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Crop plant introduction and testing, including plant classification and adaptation investigations	\$212,131	\$179,435	\$169,955	-\$9,480
2. Identification and classification of economic and plant-disease fungi	43,896	33,800	31,314	-2,486
3. Rubber production, breeding, and disease investigations	36,401	32,800	32,800	-
4. Nematology investigations	49,512	55,188	52,091	-3,097
Covered into Treasury in accordance with Public Law 574	- -	180	- -	-180
Unobligated balance	11,881	- -	- -	- -
Total estimate or appropriation	353,821	301,403	286,160	-15,243

DECREASE

The decrease of \$15,243 in this item for 1944 consists of \$180 decrease in transfers (returned to surplus in 1943) and a decrease of \$15,063, as follows:

(1) Crop plant introduction and testing, including plant classification and adaptation investigations, \$9,480. This decrease contemplates curtailment in testing work on the large plant introduction collections that have been made in recent years, now being conducted in California and Maryland; curtailment in work of preparing plant introduction and exchange materials for shipment and trans-shipment; with a reduction in clerical services and purchases of supplies.

(2) Identification and classification of economic and plant-disease fungi, \$2,486. This decrease contemplates curtailment in work on the identification of plant-disease fungi, in cooperative survey work to determine the nature and extent of plant diseases throughout the country, and in work on problems of mushroom culture.

(3) Nematology investigations, \$3,097. This decrease contemplates curtailment in work to develop practical control methods for plant diseases caused by nematodes, being conducted in Georgia, Maryland, New York, Utah, and Washington.

The estimated distribution of the decrease under this appropriation by States is as follows:

California	\$1,800	New York	200
District of Columbia	1,920	Utah	200
Georgia	350	Washington	<u>200</u>
Maryland	10,393		
			15,063

WORK UNDER THIS APPROPRIATION

Objective: The central purpose of this work is to fortify crop production, improvement, and disease-control research by introducing and providing information on foreign plants, providing data needed in disease-control studies, and gathering and disseminating information on nematodes. Emphasis is now being placed on providing foreign plant materials and information regarding them needed to produce in this hemisphere essential war crops once imported but now unavailable or scarce. More specific objectives are: (1) To supply from foreign sources--through exploration and exchange, gift, or purchase--plant materials of promise in this country; (2) to propagate for use in this hemisphere the plant materials needed to grow cinchona and other such crops for the quinine and other critical substances once imported from sources no longer available; and (3) to promote the best use of foreign plant materials in this country by obtaining and disseminating information on the plants' native habitats and natural growth habits. Other objectives in connection with work under this appropriation are: (1) To provide the armed forces with information on plants native to foreign areas; (2) to determine the rubber-bearing value of various plants, both native and introduced, and the possibilities of producing the various rubber plants in this hemisphere; (3) to maintain a reliable service in identifying plants, plant diseases, and nematodes by collecting, preserving, and making reference use of specimens of crop plants and disease organisms; (4) to collect and make available information on the incidence, identity, and current status of plant diseases throughout the United States; (5) to improve the culture of fungi, including mushrooms for food and ergot and ergot alkaloids needed for medical purposes now difficult to obtain from foreign sources; and (6) to develop practical methods to control nematodes attacking crop plants through the use of resistant crops and crop varieties, devising cultural and other means of utilizing the natural enemies of nematodes, and through studying them in the soil as related to crop production.

The Problem and its Significance: The war has altered Bureau activities on many plants such as cinchona (quinine), rotenone-producing plants, abaca and secondary fibers, oil plants, and medicinals other than quinine, which now can be obtained only in this hemisphere. Special emphasis is given to securing and transmitting propagating stocks of these important plants for use in Latin American countries to develop products that we need.

Knowledge of existing plant ranges now available and furnished war agencies has already helped in the war effort, and has emphasized the importance of an even more complete knowledge of the plants in various parts of the world. Such information can be used not only in getting plant material but for assisting in camouflage problems, in providing information on the prevalence of poisonous plants in occupied areas, and for suggesting plant products that might be obtained for various uses in emergencies where transportation difficulties might rule out usual supplies.

To safeguard incoming plant materials and existing crop plants, services for quarantine, fumigation, detention, and propagation must be maintained. It also has been necessary under present conditions, in order to expedite production in Latin America of essential plants which cannot be grown here, particularly cinchona (quinine) and derris (rotenone), to carry out preliminary mass propagation here under greenhouse conditions. Methods of transporting such materials to the place of use are also receiving attention.

Most plant material is introduced with specific uses in mind, but an occasional plant given a routine examination may prove to have important commercial characteristics not previously expected. It may prove, for example, to be a source of drying or essential oil, tannin, rubber, fiber, or food. It may also show resistance to cold, heat, drought, disease, or nematode attack and thus be useful for crossing with a commercial species in order to obtain a better variety.

To make the best possible use of an introduction, to aid in establishing production in the Western Hemisphere of medicinal and other plants needed in the United States, and to furnish assistance on camouflage and other plant problems related to the war effort, it is essential that plant species be studied their susceptibility to various diseases known, and the existence or absence of such diseases determined for the areas where a particular plant is to be used. This calls for the maintenance of extensive herbaria in which are preserved thousands of plant and plant disease specimens, so that accurate identification and classification may be assured.

General Plan: Plant introductions are planned to meet as far as practicable the needs of crop specialists in this Bureau and in cooperating state experiment stations, the Soil Conservation Service, and other agencies. An inspection service is maintained in Washington, D. C., in cooperation with the Bureau of Entomology and Plant Quarantine. Detention facilities are provided at Glenn Dale, Maryland, and testing facilities at various other places in cooperation with Federal and State agencies and a limited number of private agencies. These test areas are sources of material for use by crop specialists and for planting stock of strategic materials. Economic herbaria of plants and plant disease specimens are maintained, and technical services are rendered cooperating agencies in the identification, classification, and use of materials. A plant disease survey is kept current to reflect the situation in various parts of the United States. Nematological studies show the reaction of various plants to nematode attack and the enemies and diseases of nematodes and thus provide a basis for control measures.

Examples of Progress and Current Program:

Plant introduction and testing: Continued emphasis is being given to a program for reestablishing cinchona (quinine) culture in the Americas. Cinchona planting stock has been maintained in the collections at the plant testing stations, and to date about 20,000 trees have been sent out, particularly to Puerto Rico, Guatemala, Brazil, Panama, and other Latin American countries. A propagation program that should produce between one and three million trees by 1943 is under way.

Similar work is under way with rotenone-producing plants (derris, lonchocarpus), abaca and secondary fibers (luffa, urena, roselle, etc.), vegetable oils (African oil palm, oiticica, etc.), and medicinals other than quinine, all of importance during the emergency. A great deal of attention is being given to securing and transmitting these important propagating materials for use in Latin American countries to develop products that we need. Basic stocks of these materials are being built up at the plant testing stations. Special attention also has been given to plant problems, including camouflage, in Latin America and other areas, for the Army and Navy and the State Department.

Numerous miscellaneous inquiries are being received from war agencies regarding information on plants, plant distribution, and plant products in various parts of the world. In cooperation with the Office of Foreign Agricultural Relations, data on plants in Latin American countries are being accumulated, with particular reference to crops of interest to the United States. Many plant products of Latin America, such as quinine, rubber, rotenone, palm oils, certain oil nuts, fibers, etc., are collected in the wild, and a knowledge of their extent, distribution, and accurate identity is imperative. Reports based upon botanical and collector's notes are often the only source of information on location and distribution, available supplies, and on disease or other problems.

Exchange of plant materials has been maintained with foreign agricultural institutions and botanic gardens. From such sources during the year more than 2,100 items have been brought in and supplied to other divisions of the Bureau and to other Federal agencies and State experiment stations. Some 69,000 items have been placed in experimental plantings in this country and 7,400 sent to other countries, principally in Latin America. Over 28,000 plant specimens were received for identification from the Forest Service, Soil Conservation Service, Park Service, and other Federal agencies, state experiment stations, public and private institutions, and individuals.

Economic and plant-disease fungi: The economic fungus herbarium now totals 439,339 specimens, 16,193 additions having been made in the past fiscal year. From the standpoint of economic forms the collection is the most comprehensive in the New World and is widely used for reference and identification purposes by plant pathologists and others concerned with economic and other aspects of fungi. A number of consultations have been had with Army and Navy personnel on matters concerning fungi affecting the war effort. Studies have

been made of fungi from Argentina, Brazil, Chile, Costa Rica, Colombia, Guatemala, Mexico, Peru and Venezuela, in cooperation with agricultural officials of the countries concerned, and information furnished on plant diseases and related fungus problems. Much of this type of assistance to Latin America was formerly furnished by Germany. During the year 26,271 fungus records were added to the files together with the listing of 3,215 new species.

The collection and distribution of current information on plant disease occurrence in the United States, obtained from collaborators serving without pay, has been continued by means of the Plant Disease Reporter, a mimeographed publication issued twice a month to about 1,000 plant scientists who have periodically renewed their requests for the service. Substantial progress has been made on the preparation of a check list of diseases of economic plants of the United States for which there is urgent demand. Sections are being issued serially in preliminary form with each issue of the Plant Disease Reporter in order to partially meet the need as promptly as possible. All these activities constitute a service to other Bureau and Departmental agencies and to public and private interests working in fields directly contributory to the war effort.

Ergot and ergot alkaloids, fungus products extensively used by the medical profession in obstetrics and in checking hemorrhage, have been derived chiefly from parasitized rye occurring chiefly in Russia and in Spain. In view of possible shortage of this important drug resulting from the cutting off of former sources of supply, facilities normally devoted to mushroom culture are being temporarily directed toward the development of a practical method for the artificial cultivation of the ergot-producing fungus in the laboratory. It has been determined that high and low yielding strains of the fungus exist in nature and that desirable strains can be induced to grow vigorously in artificial culture without the presence of living rye host. The preliminary results justify the continuance of further work.

Rubber investigations: This work is closely integrated with and contributes much information of basic importance to that under the special rubber projects for plantation development in the Western Hemisphere and the production of guayule and other rubber-bearing plants. Data and experience are provided for the direction of the special work needed to obtain information of immediate application in the program for large-scale cultivation of guayule and other rubber-bearing plants in the present emergency.

Native or introduced plants found to contain significant quantities of rubber as wild plants are given preliminary tests. If they show promise they are studied intensively to determine the best methods of propagation, planting, cultivation, and harvest in relation to yield of rubber as influenced by season, and climate. Improved strains are developed by breeding and selection, and diseases affecting yield of rubber are studied. On the basis of these investigations, species which offer promise for actual rubber production will be recommended for preliminary large-scale planting to study production problems and to increase planting material of improved strains under the "Emergency Rubber Project".

On the basis of previous investigations several species have been recommended for preliminary increase under the Emergency Rubber Project. These include the Madagascar rubber vines (*Cryptostegia grandiflora*, *C. madagascariensis* and an inter-specific hybrid), the Central American rubber tree (*Castilla*), one species of goldenrod, and the desert milkweeds. Additional strains of these species that promise to be superior to those now available are being tested. Species that are not yet sufficiently proved for the large-scale tests but which have shown appreciable quantities of rubber include many species of milkweed, goldenrod, Indian hemp, rabbit brush, the Colorado rubber weed, the rubber cucumber of Madagascar, the rubber withe of Jamaica, relatives of the Ceara rubber tree of Brazil, the African rubber vine, and dandelion and oyster plant relatives from Russia.

Further progress has been made in selecting and providing high-yielding strains of goldenrod. Sufficient planting material of the best strains was supplied to plant 150 acres for testing under the Emergency Rubber Project. A satisfactory method of large-scale extraction of rubber from goldenrod is not available. Goldenrod leaves were furnished to the United States Rubber Company for extraction tests and several hundred pounds of leaves were furnished the Bureau of Agricultural Chemistry and Engineering for special tests. If extraction methods are developed, extensive emergency production of goldenrod could be undertaken on marginal lands in the Southeast.

Studies of species of *Cryptostegia* and of an interspecific hybrid have indicated the potential value of these plants in the war emergency. Rubber is contained in leaves, stems, and roots of *Cryptostegia* and, if properly extracted, is of excellent quality. Indicated yields are not high but the plants are thrifty growers, easily propagated and a first harvest is possible in a single year, with increased yields in successive years.

Species of *Castilla*, the Central American rubber tree, have been introduced into the southern United States, where they have grown to maturity. Preliminary tests indicate the desirability of testing this tree as an annual crop, the seedlings being cut off at the ground at the end of the first year and annually thereafter. Rubber has been extracted in an experimental cane mill.

Hundreds of plants submitted by Government agencies and private individuals all over the world have been analyzed for rubber and reports submitted as to their potential use for emergency rubber production.

Nematodes: These microscopic plant pests are significant factors in reducing the efficiency of the country's agricultural production, attacking many crops that are vital in the war emergency. In California the root-knot nematode is considered the most serious agricultural disease problem in the State. The estimated loss of tomatoes for market caused by the root-knot nematode in three southern states in 1939 was 90,000 bushels, and the annual loss to garden crops, potatoes, alfalfa, sugar beets and other crops is severe in many areas.

Surveys have been made of areas for gyaule nurseries and plantings, to avoid as much as possible of the nematode damage to this important war crop. Meth bromide continues to prove a very effective soil fumigant against nematodes, particularly for smaller quantities of potting or seed bed soil. Lespedeza stipulacea is extremely susceptible to root-knot, and is being used as an indicator to determine the degree of infestation in soils. Work on control meth for root-knot on infested potato land in the Klamath Falls, Oregon, region indicates that grains and grasses are the only crops that may be recommended rotation control, provided they are kept free from weeds. Work has been started in cooperation with the New York Experiment Station on the potato nematode, most important nematode plant pest of northern Europe, found for the first time in this country in 1941 on potatoes on Long Island. Work has been discontinued on the control of bulb nematode in narcissus, with the development of a satisfactory hot water-formalin treatment. Progress is being made on the differentiation of forms of the meadow nematode attacking potatoes, alfalfa, corn, strawberry plants.

(1) PLANT INDUSTRY EXPERIMENT FARM

Appropriation Act, 1943	\$51,109
Budget estimate, 1944	<u>48,550</u>
Decrease	<u>-2,559</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Plant Industry Experiment Farm -				
Maintenance of facilities for				
basic plant research	\$50,250	\$51,109	\$48,550	-\$2,559
Unobligated balance	64	-	-	-
Total estimate or appropriation:	50,314	51,109	48,550	-2,559

DECREASE

(1) The decrease of \$2,559 in this item for 1944 will be effected by reduced expenditures for supplies, equipment, utilities, and other services.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

(1) Soil management and fertilizer investigations, \$10,540. This decrease contemplates curtailment in cooperative research on the use of green manuring crops in rotation for conservation of applied plant-foods and soil improvement; the relation of organic matter to soil productivity under different climatic conditions and cropping systems; improving phosphate fertilizers and methods of increasing their efficiency for crop fertilization; investigations in plant nutrition and plant composition as influenced by soils and fertilizers.

(2) Soil microbiology investigations, \$2,611. This decrease contemplates curtailment in investigations of organisms concerned with decomposition of organic matter and formation of humus in soils, and of nitrogen-fixing micro-organisms in the soil, as related to soil improvement and crop production.

(3) Soil chemical and physical investigations, \$3,695. This decrease contemplates curtailment in services rendered to other agencies in analyzing soils; and in studies on the relation between soil composition and the efficiency of the utilization of commercial fertilizers.

WORK UNDER THIS APPROPRIATION

Objective: The war has caused a drastic change in the objectives of work conducted under this appropriation, and the work itself has been shifted so as to meet directly the problems related to the war. The outstanding objectives are: (1) To assist in promoting the most effective use of fertilizer resources in meeting crop production goals; (2) to evaluate by-products of war industries that may be used as fertilizers or in the manufacture of fertilizer; (3) to assist the military in solving problems related to soil usage, fertilization, and crop production encountered in military operations; (4) to assist the military in connection with problems that can be effectively studied with the equipment and personnel of the Division.

Other objectives are: (1) To develop new and more efficient fertilizers and methods for their use on various crops; (2) to determine the influence of green-manuring and organic matter on the utilization of commercial plant-foods; (3) to determine the physical and chemical properties of soils and their relation to fertilizer practice, soil fertility, and methods of soil management; (4) to determine the relationship soil micro-organisms have to soil fertility, soil management, and the control of soil-borne diseases.

The Problem and its Significance: War conditions involve many problems in connection with fertilizers and the use of soils. Imports of certain fertilizer materials have been cut off or made difficult. Problems regarding the supply of sulphuric acid have threatened the adequate production of superphosphate. Nitrogen demands for munitions purposes have limited the quantity of nitrogen available for fertilizers. Transportation difficulties have made it necessary to change industrial equipment used in handling shipments and to alter the composition of fertilizer mixtures so as to conserve transportation space.

Military needs for turf-covered airplane fields and landing strips and for rapid stabilization of soils for emergency use by invasion forces where mechanized equipment is used, have presented problems involving soil information on turf growing and on the chemical and physical properties required for different uses under varied conditions.

In recent years more than 9,000,000 tons of commercial fertilizer have been used per annum in this country. Continued research on the development of fertilizer materials, methods of manufacture, and improved methods of fertilization of specific crops on various soils is essential if American farmers are to get the maximum returns for their \$250,000,000 investment in fertilizers. One of the major problems in this field relates to possible post-war utilization, for fertilizer purposes, of the synthetic ammonia capacity of war plants. These plants, some ten in number, may be available in part for the production of nitrogen fertilizers. Their proper utilization will require a great deal of research in both the production and use of nitrogen fertilizers.

Soil management is the key to successful farming and a permanent agriculture. Results of studies in soil chemistry, physics, and microbiology are essential to the interpretation of results observed in field experiments and on the farm, to the development of improved conservation - cultural practices, and to a better understanding of factors influencing the efficiency of fertilizers and soil management practices.

General Plan: War problems are given first place in the utilization of equipment and personnel. Fortunately, the basic research of the Bureau in past years has been very useful to several of the war agencies. Such material has been presented in special reports to the proper authorities. In several instances members of the Division have made special studies and reports for war agencies.

Investigations relating to fertilizers, soil fertility and management, and soil microbiology are being closely correlated with the work of state agricultural experiment stations. Thus, as a new fertilizer is developed, it is tested at several state agricultural experiment stations as well as at the Bureau's Beltsville station. A similar procedure is followed in soil management studies.

Examples of Progress and Current Program:

Soil management and fertilizer investigations:

Conserving nitrogen. The enormous demands for use in manufacturing munitions and the difficulties encountered in importing Chilean nitrate have created an appreciable shortage of nitrogen material for agriculture, resulting in a system for apportioning its distribution for the 1942 fertilizer season. This shortage will be reduced by the equivalent of about 40,000 tons of commercial sodium nitrate per year through the use of a by-product from the manufacture of explosives, which the Bureau's research has shown to be a

desirable fertilizer material. Reports have been prepared on the fertilizer consumption by the principal crops, on the effect of nitrogen fertilization on yields and qualities of crops, and assistance has been rendered in the plan for distributing fertilizers. Because of the urgent problems connected with the needs and supply, advice and assistance have been given to the Office for Agricultural War Relations, the War Production Board, the Office of Price Administration, and other war agencies, in regard to numerous problems connected with the supply, needs, and distribution of nitrogen fertilizer materials.

Phosphate fertilizers. Investigations are being conducted on the utilization of spent by-product sulphuric acid for the production of superphosphate, and the suitability of superphosphate prepared with this acid for fertilizer use is being determined. This will have an effect of relieving the stringency in supplies of sulphuric acid due to war demands. The recovery and utilization of vanadium from Western superphosphate is being investigated since vanadium is urgently needed as a war material.

Emphasis has been placed on developing and testing new phosphate fertilizers of high concentration, on the preparation of phosphate materials that will be resistant to fixation in the soil and thus be more readily available to plants, and on the utilization of low-grade phosphates.

Advisory services have been given to the Office for Agricultural War Relations, the War Production Board, and the Office of Price Administration regarding phosphates. These services include special reports on studies of supplies of phosphate fertilizer and of sulphuric acid for the manufacture of superphosphate.

Potash fertilizers. Before the first World War the United States was entirely dependent upon Germany for potash materials. Due to that situation, efforts were made to provide domestic sources of potash. As a result of investigations participated in by the Bureau, other governmental agencies, and industrial concerns, potash is now being obtained from mining operations in New Mexico and from the utilization of brine deposits in California. While supplies of potash materials are adequate to meet present requirements, new materials of higher concentration are being developed to save shipping space, and insure cheaper transportation. Potassium metaphosphate, 40 percent potash and 60 percent phosphoric oxide, falls in this category, and it is being evaluated by plant tests to determine its relative efficiency as a carrier of both potassium and phosphorus, in comparison with standard sources of these essential plant-food elements.

Information has been made available to war agencies regarding supplies, amounts consumed in the past, and probable requirements under war conditions. Reports have been prepared and advice given to the Office for Agricultural War Relations and other war agencies regarding problems concerning potash, such as the available amounts of materials of different concentration, the substitution of some forms of potash for others less readily obtainable, and the suitability of materials for export under the Lend-Lease program.

Mixed fertilizers. Information and Advice are being supplied to the Office for Agricultural War Relations, the Office of Price Administration, and other war agencies concerning supplies of materials, records of consumption and probable demands for fertilizer for use on various crops and in various states to meet the Department's war production program.

During the year workers participated in an active campaign undertaken by the Department to increase the plant food content of mixed fertilizers in order to reduce the burden on transportation facilities and to decrease the labor necessary in handling and the number of bags required to ship fertilizers. resultant order of the War Production Board has placed minimum limits on plant food content in fertilizers that may be transported by common carrier. Changes in grades that must be made and limitations of supplies of some materials give rise to problems that require immediate attention in order to protect the farmers' interests and to maintain food production goals.

Emphasis is being placed on solving emergency problems, especially to insure maximum production of essential food crops, such as soybeans, peanuts, vegetable crops, and sugar beets.

Special war activities. The problem of increasing the amount of gas, such as oxygen, that may be enclosed in metal cylinders used by airplanes is being investigated under the direction of the Bureau of Aeronautics, U. S. Navy. the solution of this problem, the number of cylinders required for a plane will be lessened, thereby releasing cargo space and weight.

Assistance is being given the Quartermaster Corps in testing the qualities and properties of materials and equipment for use by combat forces under different usages and extreme climatic conditions.

Spectrographic methods for the rapid determination of the composition of gases remaining in gun barrels after discharge are under investigation in operation with the National Research Council.

Spectrographic and other rapid methods for determining the amount of rubber-bearing plants are being studied in cooperation with the emergency rubber project of the Bureau.

The machine and instrument shop is being called upon continuously to perform services requiring precision work and special skills for many of the war agencies. Representative of these services are (a) the construction of a planimeter for a machine used for the accurate measurement of aerial maps being prepared by the Soil Conservation Service for war use; (b) the construction of a mirror and holder for use in connection with aerial photography and map drafting for war use; (c) the construction of a seed testing instrument for the Agricultural Marketing Administration; (d) the construction of a seed counter and the cleaning, repairing, and testing of thermographs for the Special Guayule Research Project of the Department; and (e) the construction of glass apparatus for the Naval Research Laboratory and the Naval Ordnance Laboratory, U. S. Navy.

Soil microbiology investigations:

Soil organisms and organic matter. Emphasis is being shifted from the isolation and identification of organisms to their practical application in treatment of different soils to improve growing conditions of special crops. The objective is to determine suitable organic materials to be used in preparing soils for growing turf covers on airplane fields, to utilize legumes in improving soils for growing crops to meet war requirements, and to determine measures most effective in conserving animal manures and waste organic products on decomposition. The work is being done in cooperation with other units in the Bureau, the Soil Conservation Service, the Army, and other war agencies.

Legume inoculation. Adding nitrogen-fixing bacteria to legume seed or to the soil in which it is planted is a well recognized practice, called inoculation. With the expansion of legume acreage and the introduction of new crops, the search for superior strains of inoculant for the common, as well as the rarer legumes, is essential in insuring soil improvement from the legumes.

Many samples of inoculants have been furnished to farmers and to investigators for inoculating special crops. This work is of particular importance in the Department program for increasing the use of legumes, the first requirement of which was the production of seed sufficient for planting additional legume acreage. A waste of seed would result in many places unless inoculants were available. Not only is this service important in the successful growth of legume crops, the production of feed and forage for beef cattle and dairy herds, but also in the use of legumes in rotations to furnish a source of nitrogen to succeeding crops. Thus yield requirements to meet the war program are maintained, where failure might otherwise result from inability to obtain sufficient nitrogen in fertilizers under present shortages. The employment of proper soil management practices is of special importance in obtaining successful yields of soybeans, peanuts, and other legume and oil crops under the present emergency conditions.

During 1941 over 400 samples of commercial inoculants were tested in greenhouse trials. Results indicated that the general quality was good, except for failure of certain inoculants for clovers. Steps have been taken to correct the situation with respect to these inoculants.

Soil chemical and physical investigations:

Soil chemical and physical properties. Emphasis is being placed on the solution of problems met by the Army Air Corps, Navy Department, and Civil Aeronautics Authority in (1) stabilizing soils of various textures under different climatic conditions for the preparation of areas of sufficient bearing strength for the establishment of emergency beach heads, landing fields, and roadways; and (2) establishing and maintaining turf on air fields in cooperation with the Divisions of Soil Survey and Forage Crops and Diseases of this Bureau, the Soil Conservation Service, and the Public Roads Administration.

Tests are being conducted on the reactions taking place between soils and the fertilizers applied to obtain facts on the use of suitable forms of fertilizer and more effective methods of fertilizer applications. The results, taken in conjunction with information obtainable from mechanical and chemical analyses, are providing information on which to base soil management programs for greater production of crops in the war goals.

(o) SOIL SURVEY

Appropriation Act, 1943	\$205,430
Budget estimate, 1944	<u>195,160</u>
Decrease	<u>-10,270</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Investigations, classification, and mapping of soils:				
(a) Investigations, classification, and mapping of soils in the fields ^{a/}	\$144,950	\$79,265	\$76,765	-\$2,5
(b) Field inspection of soil surveys and correlation of soil types and series	70,135	72,800	68,800	-4,0
(c) Adjusting, construction, and drafting soil maps and charts for reproduction	50,870	53,365	49,595	-3,7
Unobligated balance	11,400	- -	- -	-
Total estimate or appropriation	277,355	205,430	195,160	-10,2

^{a/} For the duration of the war emergency, field mapping has been suspended except for work in the Tennessee Valley, and personnel are assigned to soil problems in connection with expansion of emergency crops, such as guayule, goldenrod, hemp, castor beans, drug plants, etc.

DECREASE

(1) The decrease of \$10,270 in this item for 1944, distributed by project indicated above, will be met by reducing expenditures for soil survey work in Tennessee, inspection and correlation of surveys in the West Coast States, drafting of soil survey maps.

WORK UNDER THIS APPROPRIATION

Objective: The underlying purpose of classifying and mapping the soils of the United States is to provide accurate, detailed information for increasing the efficiency of crop production and for developing improved farm programs--information that will be published and readily available to farmers, farm associations, state and Federal agencies, and others concerned with the best use of rural lands. This involves the classification of soils in a national system on the basis of field and laboratory investigations; the indication of their extent and distribution upon maps; the explanation of their possibilities for producing adapted crops, grasses, and trees, in terms of yield and management requirements; and recommendations for their stability and conservation under alternative systems of farm management. During wartime special emphasis is given to determining the suitability, location, and management requirements of soil for crops vitally needed in the war effort--crops such as hemp, peanuts, castor beans, and others, that must be put on suitable types of soil if production goals are to be attained--and to provide soil maps and related findings that are needed in airport construction and other war projects.

The Problem and its Significance: By relating the experience of farmers and the results of agricultural research to definite soil types, individual farmers apply the information to the particular soil types on their own farms. There are several thousand soil types in the United States, different from one another in a few or in all of their important characteristics that determine their usefulness for various crops, pastures, or trees. Soils also vary in their response to cultural practices. Methods of soil management that lead to high production and soil conservation on one soil type may be less useful, or even ruinous, on another. Some soils are benefited by terracing, others are not; some are acid and respond to liming, others do not; some in dry regions can be irrigated successfully, others cannot be; some are very susceptible to blowing or washing, others are not. The crops, or varieties of crops, that can be grown with success, the needs for fertilizers to produce good yields of crops high in quality and nutritional values, and the effectiveness of various tillage methods are all different on different soil types.

War crops, like hemp, peanuts, castor beans, and gunyule and the other rubber plants, have their own special soil requirements for economical and efficient production. Proper groupings of soil types and special interpretations of soil maps, or even special maps in some cases, are essential to rapid and dependable expansion of crops vital to the war effort.

The main problem of the Soil Survey is to maintain a system of classification that can be used by all agricultural technicians and agencies. In constructing maps of soil types and developing descriptions and ratings of soil types, it is of basic importance to use standard terms and symbols so that significant differences are understood clearly and definitely as they apply to individual fields and farms, and to particular crop production problems.

The system of classification must be carefully coordinated on a national basis, in cooperation with the state agricultural experiment stations, so that similar soil types are everywhere given the same names and definitions. Standards of soil nomenclature, definition, and classification are essential to the successful conduct and application of agricultural research.

The drastic crop adjustments called for in the present emergency can be made quickly and effectively only on the basis of an accurate knowledge of the soil conditions. Accurate soil maps are extensively used as factual guides in the agricultural programs of the state governments, the Department of Agriculture, the Tennessee Valley Authority, and other agencies. Farmers, prospective farmers, and especially county agricultural agents, use these maps in order to make use of the results of agricultural research as applied to specific fields.

General Plan: The Soil Survey is conducted cooperatively with the appropriate state agencies, especially the state agricultural experiment stations, and with the Soil Conservation Service, the Tennessee Valley Authority, and other Federal agencies. At least some work has been done in every state and Territory, but more has been done in those States making large financial contributions toward the work. Active work has been under way recently, for at least a part of the year, in 30 to 35 states. (Many of the scientists in the Soil Survey are now assigned to special projects dealing with the expansion of war crops, and the cooperative soil mapping work with the state agricultural experiment stations is continuing at a reduced rate).

Scientists of the Bureau cooperate with other public agencies, including the Bureau of Agricultural Economics, the Farm Credit Administration, the Soil Conservation Service, the Farm Security Administration, the Tennessee Valley Authority, the Forest Service, the Bureau of Reclamation and the Bureau of Indian Affairs in developing agricultural and land programs that involve needs for a knowledge of soil and for the interpretation of soil maps and other soil research.

Under the present emergency, scientists of the Bureau are making soil surveys only in areas of special significance to the war. A large part of the survey force is necessarily engaged upon special surveys and investigations to determine where vital war crops may be extended most economically and quickly.

For effectiveness, the Soil Survey work is coordinated on a national basis so that similar soils are everywhere given the same names and descriptions in all states. At the same time, the state scientists contribute their detailed local experience. This cooperative basis makes it possible to have the benefits of both local and national experience and to develop a common nomenclature that fits local conditions.

The Soil Survey not only sees that soil types are accurately and uniformly defined and mapped but also cooperates with other divisions of the Bureau in coordinating the results of other plant and soil research with the findings

regarding soil types and soil groups recognized in the system of classification. It is through the medium of soil classification and soil maps that much of the Bureau's work finds application to specific fields, farms, and rural communities.

Examples of Progress and Current Program: Accurate standard soil maps, or specially prepared soil maps, properly interpreted, are essential for effective planning of crops needed in the war effort, for airport construction, and for other war projects. Several soil scientists are engaged in planning war goals in agricultural production and the expansion of individual war crops. Some, for example, are now with the Emergency Rubber Project in the field selecting soil for the production of guayule, which has particular soil requirements. Those in charge of the guayule production program assert that without careful soil examination of the kind used in soil classification and mapping it would be impossible to plan the work effectively and speedily. Similar studies of goldenrod, peanuts, castor beans, hemp, and other crops are under way. Special efforts are being made to assist the Tennessee Valley Authority to appraise the land and to plan the acquisition of land back of the new dams being rushed to provide power for aluminum production.

All survey inspection and soil classification work in the Department of Agriculture was consolidated in the Bureau of Plant Industry by an order of the Secretary effective September 1, 1942. Although the technical responsibility for this work had always been in the Soil Survey, previously part of the inspection force had been employed in the Soil Conservation Service. The consolidation was made with a view to achieving more effective administration and conduct of the work so that all soil classification and mapping done by the Department will fulfill the immediate needs of agricultural conservation and adjustment programs as well as contribute to the basic soil survey of the whole country.

During the fiscal year ending June 30, 1942, soil surveys of 9 areas, mostly counties, were released by the Government Printer as follows:

California:	Sacramento-San Joaquin	North Dakota:	McKenzie County
	Delta area	Puerto Rico:	Entire Island
Georgia:	Catoosa County	Tennessee:	Jefferson County
Iowa:	Story County	Texas:	Maverick County
Minnesota:	Roseau County	West Virginia:	Greenbrier County

On July 1, 1942, 47 soil survey reports, exclusive of reprints, were in the hands of the Government Printer, as follows:

Alabama:	Macon County	North Carolina:	Henderson County
California:	Bakersfield area		Madison County
	Pixley area		Warren County
	Tracy area	North Dakota:	Billings County
	Santa Cruz area	Ohio:	Lucas County
	Wasco area	Oklahoma:	Choctaw County
			Tulsa

Georgia:	Dade County	Pennsylvania:	Huntingdon County
Idaho:	Blackfoot-Aberdeen area	Rhode Island:	Providence County
Indiana:	Bartholomew County		Newport and Brist Counties
	Brown County	South Carolina:	Pickens County
	Knox County		Sumter County
	LaPorte County	Tennessee:	Humphreys County
	Martin County		Lincoln County
	Vanderburgh County		Roane County
Kentucky:	Calloway County	Texas:	Dimmit County
Michigan:	Clinton County		Fannin County
Mississippi:	Tishomingo County	Utah:	Salt Lake Area
Missouri:	Linn County	Utah & Arizona:	Virgin River Vall area
Montana:	Big Horn Valley area	Virginia:	Russell County
	Upper Musselshell Valley area		Washington County
New Hampshire:	Cheshire & Sullivan Cos.	Washington:	Kittitas County
	Coos County		
New York	Albany and Schenectady Cos.		
	Seneca County		
	Sullivan County		

Field mapping in various areas through the country amounting to 12,177 square miles of detailed soil survey and 2,031 square miles of reconnaissance (equivalent to 20 to 24 areas) was completed in cooperation with the States. Progress during 1943 is continuing on a reduced scale because of the demands of other critical soil problems related to the war.

(p) SOIL CONSERVATION SERVICE (Allotment to Bureau of Plant Industry)

This budget schedule covers obligations (\$148,132 for 1943 and \$177,758 on a full-year basis for 1944) under an allotment to the Bureau of Plant Industry for inspection and correlation of surveys made by the Soil Conservation Service, as mentioned under the immediately preceding item for soil survey.

(q) SUGAR-PLANT INVESTIGATIONS

Appropriation Act, 1943.....	\$371,225
Proposed transfers in 1944 estimates to	
"Salaries and expenses, Office of	
Administrator, Agricultural Research	
Administration".....	-1,500
Total available, 1943.....	<u>369,725</u>
Budget estimate, 1944.....	<u>350,340</u>
Decrease (including decrease of 1945	
travel funds returned to surplus).....	<u>-19,385</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Sugar-plant production, breed-				
ing, disease, and quality				
investigations:				
(a) Sugar-beets	\$201,870:	\$203,960 :	\$193,770 :-	\$10,190 (1)
(b) Sugarcane	130,050:	134,985 :	128,215 :-	6,770 (2)
(c) Sugar sorghums	28,150:	29,835 :	28,355 :-	1,480 (3)
Covered into Treasury in ac-				
cordance with Public Law 674	945 :	-- :-	945
Unobligated balance.....	<u>7,400:</u>	-- :	-- :-	--
Total estimate, 1944, and				
comparable amounts, 1943				
and 1942	367,470:	369,725 :	350,340 :-	19,385

DECREASE

The decrease of \$19,385 in this item for 1944 consists of \$945 decrease in travel funds (returned to surplus in 1943) and a decrease of \$18,440 as follows:

(1) Sugar-beets, \$10,190. This decrease contemplates curtailment in sugar-beet research on control of curly-top, improvement of disease resistance, adaptation of the sugar-beet seed industry to new areas, and improvement of cultural practices, in California, Colorado, and other beet-growing states, with a reduction in services at Beltsville, Maryland.

(2) Sugarcane, \$6,770. This decrease contemplates curtailment of work in the Gulf States on problems of sugarcane production, including improvement of varieties for disease resistance, high yield, and other desirable qualities, and cultural and fertilizer practices, with a reduction in services at Beltsville; Maryland.

(3) Sugar sorghums, \$1,480. This decrease contemplates curtailment of investigations to develop varieties of sugar sorghum improved in percentage of sugar and yielding capacity per acre, and to determine the suitability of improved varieties for culture in different states.

The estimated distribution of the decrease by States is as follows:

California	\$4,600	Mississippi	1,500
Colorado	2,000	Nebraska	550
Florida	880	New Mexico	250
Georgia	400	Ohio	250
Louisiana	3,500	Oregon	275
Maryland	3,810	Canal Zone	200
Minnesota	225		
			18,140

WORK UNDER THIS APPROPRIATION

Objective: To meet national wartime needs for sugar by increased production of sugar crops in the United States, despite shortages in farm labor, machinery, fertilizers, and other supplies, by means of: (1) Improved practices to obtain better and more uniform stands, to reduce the labor requirements for thinning, weeding, and harvesting, and to increase the efficiency of fertilizer use; (2) the increase and distribution for widespread use, of new and improved disease-resistant varieties of sugar beets, sugarcane, and sugar sorghums to prevent losses from disease and other controllable hazards; and (3) insuring adequate supplies of domestically grown seed.

The Problem and its Significance: Under stress of war conditions, domestic production of sugar and sirups from sugar beets, sugarcane, and sugar sorghums assumes new significance. Sugar was the first foodstuff rationed when importations, normally supplying 70 percent of our requirements, were drastically reduced. There is at the same time an increased sugar demand by the fighting forces, not only for food, but also for basic materials needed in munitions manufacture.

The sugar crops of the United States represent an investment in facilities of nearly three-quarters of a billion dollars. Investments in subsidiary industries furnishing supplies and services and utilizing by-products increase the total to approximately a billion dollars.

In response to the national need, 1942 acreages of sugar plants approached the largest in our history. Sugar beets for sugar were planted on 1,061,000 acres in 21 states. Nearly 10,000 additional acres were used for sugar-bee seed production. In the Southern States, 301,000 sugarcane acres were plan

for sugar, approximately 125,000 for sirup, and about 30,000 for seed cane. Sugar sorghum for sirup production occupied about 236,000 acres in 18 states.

The research program is directed to finding ways to attain goals in the face of shortages in manpower, machines, and essential fertilizer supplies. Emphasis is being placed on the discovery of new short cuts, new labor-saving devices, new methods, and better fertilizer use.

Production costs with sugar crops are relatively high. Labor requirements per acre of production are large. Unfavorable seasonal or disease conditions may make the crop in one district or another unprofitable or marginal. Even under normal economic conditions, greater efficiency in producing sugar crops in the United States is essential. Under war conditions, with the need for increased production, there is added need for applied research. At this time the nation cannot afford any sugar losses in the field or wastes in production that can possibly be prevented.

General Plan: The work is organized under three headings (a) sugar beets, (b) sugarcane, and (c) sugar sorghums. Sugar-beet investigations, in large part conducted in cooperation with state agricultural experiment stations, are carried on near centers of sugar-beet production at East Lansing, Michigan; Wooster and Holgate, Ohio; St. Paul, Minnesota; Scottsbluff, Nebraska; Fort Collins, Colorado; State College, New Mexico; Salt Lake City, Utah; Twin Falls, Idaho; Riverside, California; and Corvallis, Oregon. Intensive improvement investigations, previously at Arlington Farm, are conducted at Beltsville, Maryland.

Sugarcane investigations are conducted at Canal Point, Florida; Houma, Louisiana; Cairo, Georgia; Meridian, Mississippi; Summit, Panama Canal Zone; and Beltsville, Maryland.

Sugar-sorghum investigations are conducted chiefly in the Southern States, with some work in Iowa, Minnesota, Nebraska, Colorado, Utah, and California.

Examples of Progress and Current Program:

Sugar-beet production, breeding, disease, and quality investigations:

Breeding investigations of the Bureau of Plant Industry supply the Foundation stocks for approximately two-thirds of the 18,000,000 pounds of sugar-beet seed grown annually in the United States. The superior varieties coming from this source are necessary to maintain production. The sugar-beet seed crop grown in 8 Western States is not only the sole seed supply for the American industry, but also provides seed for Allied countries. Seed is now being produced for Great Britain, Canada, Australia, Uruguay, and other friendly countries. Demands for seed have reached such proportions that research to increase efficiency in seed production and to safeguard the seed crop from disease loss has become a necessary part of the war effort, and is being given special emphasis.

Leaf spot, root rot, and curly-top, if unchecked, seriously limit production. The new leaf-spot-resistant variety, U.S. 215 X 216, developed by the Bureau, will be grown extensively in 1943 in the more eastern districts where leaf spot is serious. The effect of different soil and climates on seed yields is being emphasized, and seed fields for different varieties are now being placed in localities better suited to each. Control of the leaf spots and of downy mildew affecting seed beets is being worked out. Downy mildew resistance is being included in the breeding program, and results already indicate marked improvements in existing curly-top-resistant types in this respect. Curly-top control investigations are centered on breeding varieties still more resistant to the curly-top virus than previous introductions. These investigations have been reorganized to speed up the increase of more productive varieties of sugar beets for the western curly-top area. Seed of U.S. 22, more resistant to curly-top than any variety previously released, first became generally available to grower in 1942. In 1941 and again in 1942 this variety had given especially good results where curly-top exposure was severe. As a result of further advance "Improved U.S. 22" soon will be available for farmers. Research on the curly-top virus is centering on the resistance-breeding program to determine how the virus strain situation affects breeding, and to work out seed production of curly-top-resistant strains. Progress is being made in combining in curly-top-resistant varieties resistance to downy mildew and leaf spot, higher yields, and non-bolting (that is, not going to seed the first year when used in winter plantings). The Bureau introduction U.S. 15, the leading non-bolting variety, of which nearly 2,000,000 pounds of seed were available for use in 1942, shortly will be replaced by "Improved U.S. 15", still better adapted to California conditions.

Substitutes for copper and mercury fungicides may have to be used for control of seedling diseases and rotting of roots by soil fungi. Certain non-metallic fungicides now under test have shown promise, and can be used should metallic fungicides be restricted.

Emphasis has been placed on the discovery and testing of labor-saving practices. Segmenting the beet seed ball to permit planting of seed units instead of seed clusters is being tested to reduce hand labor in thinning sugar beets. Tests in Michigan, Ohio, Minnesota, Nebraska, Colorado, Utah, and Idaho have shown regions where this method is applicable. More efficient use of irrigation water and fertilizers is being investigated, and information obtained already is serving to increase the efficiency of production.

Sugarcane production, breeding, disease, and quality investigations: The Bureau's sugarcane program is centered on the increase and introduction of new disease-resistant varieties of sugarcane capable of producing more total sugar, with incidental increase in by-product molasses; improved means for controlling diseases causing reduction in yields; determination of minimum nitrogen required as fertilizer consistent with optimum yields of cane, important because of nitrogen shortages; and means for reducing losses of sugar in cane injured by frost late in the harvesting season.

Seed cane of a new improved variety of sugarcane, C.P. 34/120, has been rapidly increased to meet planting requirements for the fall of 1942 in Louisiana.

Special attention is being given to controlling the chlorotic streak disease of sugarcane, first discovered in Louisiana in 1937 and now prevalent throughout the state. Eliminating diseased plants and selecting disease-free cane for planting are recommended practices now being followed on a number of plantations. Hot-water baths for infected seed cane give some control, but are expensive and not generally satisfactory. Fortunately, some of the new canes bred for mosaic resistance also show some resistance to chlorotic streak, and work is going forward to develop canes combining a high degree of resistance to both diseases.

Sugar sorghum production, breeding, disease, and quality investigations:
This work, started with funds provided in the appropriation for the fiscal year 1942, is directed to developing a supplementary source for domestic production of sugar from sorghum. The objectives of the program are (1) the breeding and development of improved varieties of sugar sorghum adapted for sugar production under varying soil and climatic conditions, (2) extending the period of profitable employment of farm labor, (3) extending the profitable utilization of sugarcane mills and sugar-beet factories where equipment valued at two hundred million dollars is now used for only 75 to 100 days per year, with corresponding extension of profitable employment of factory and transport labor.

Personnel of the Bureau assisted in growing 7,000 acres of sugar sorghum in Louisiana in 1942 for industrial alcohol production. This trial, completed with a reasonable degree of success, has proved that sugar sorghums can be used as an additional source of industrial alcohol needed for munition manufacture. Seed stocks of sugar sorghums are being built up, and breeding investigations are in progress to improve existing stocks.

(r) TOBACCO INVESTIGATIONS

Appropriation Act, 1943	\$126,950
Budget estimate, 1944	<u>120,520</u>
Decrease (including decrease of \$90 travel funds returned to surplus) ...	<u><u>-6,430</u></u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Flue-cured, burley, Maryland, and other tobacco production, breeding, disease, and quality investigations	\$137,934	\$126,860	\$120,520	- \$6,340
Covered into Treasury in ac- cordance with Public Law 674	--	90	--	- 90
Unobligated balance	3,510	--	--	--
Total estimate or appropri- ation	141,444	126,950	120,520	- 6,430

DECREASE

The decrease of \$6,430 in this item for 1944 consists of \$90 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$6,340 that contemplates curtailment of cooperative work control of tobacco diseases at Madison, Wisconsin; Tifton, Georgia; Raleigh, North Carolina; Greenville, Tennessee; and Beltsville, Maryland. Curtailment also is contemplated in tobacco production and improvement work, relating chiefly to fertilizer and nutrition studies, in Georgia, South Carolina, Tennessee, and Maryland.

The estimated distribution of the decrease by States is as follows:

Georgia	\$500	South Carolina	600
Maryland	2,520	Tennessee	920
North Carolina	100	Wisconsin	1,700
			6,340

WORK UNDER THIS APPROPRIATION

Objective: Under wartime shortages of farm labor, materials, and equipment the principal objective of the Bureau's tobacco investigations is to aid growers in maintaining production from the limited acreage they will be able to grow under these conditions, by reducing losses from disease and other hazards, improving the yield of desirable grades of leaf, and reducing costs of production.

The Problem and its Significance: The annual tobacco crop of about 1,400,000,000 pounds, with a farm value of more than \$300,000,000, is grown on 1,500,000 acres distributed mainly through 15 states. In the principal producing areas tobacco is the chief cash crop of the growers. Taxes on manufactured tobacco yield an annual Federal revenue of about \$700,000,000.

In order that growers may realize fair returns from the limited tobacco acreage they will be able to maintain under existing conditions, it is essential that they produce the maximum possible yields of the grades of leaf required for domestic manufacturing purposes. Many of the present varieties and strains of tobacco are poorly adapted to production of the types and grades of leaf now in active demand, particularly when grown on other than the very best tobacco soils. Problems of weed and disease control and proper soil tilth, resulting from more or less general transfer of plant beds from newly reclaimed wood land to old land in the field, are emphasized by a present scarcity of equipment for steaming plant bed soil. In the field, systems of cropping and soil management are needed which will minimize the hazards of unfavorable weather conditions, and at the same time avoid injury to the quality of tobacco likely to result from growing leguminous crops such as soybeans and lespedeza, as a result of the accumulation of nitrogen in the soil, a factor that must be watched carefully in connection with tobacco. There is, also, the special problem of growing tobacco as a source of nicotine for insecticidal use and to partially replace the culture of dark tobaccos no longer in demand.

Diseases reduce the value of the crop each year by 10 to 20 percent. In the South probably 500,000 acres of tobacco are grown on root-knot infested soil, entailing heavy losses; in central North Carolina Franville wilt has reduced by one-half the value of the finest tobacco soils; blue mold has cost the growers several million dollars in additional seed beds planted; in some years epidemics of wildfire are highly destructive; the new, destructive, black shank is spreading in the South; in northern areas, black root-rot seriously injures the crop.

General Plan: Each distinctive type of tobacco presents special cultural problems because of varying standards of quality and regional differences in soil, climate, disease distribution, and other factors. Cooperative experiments are carried out with the agricultural experiment station of the tobacco-growing states of Pennsylvania, Maryland, North Carolina, South Carolina, Georgia, Tennessee, and Wisconsin. No independent field stations are maintained.

Examples of Progress and Current Program:

Facts to meet emergency needs: One of the chief immediate problems confronting tobacco growers is shortage in the supply of experienced farm labor. The most effective use of the labor available will depend largely on the application of proper measures to minimize losses from disease and unfavorable weather conditions; adequate, well-balanced fertilization of the crop; use of improved varieties; employment of more intensive systems of cropping and soil management which will not impair the quality of the tobacco. The growers also are faced with additional problems because of scarcity of materials and necessary equipment.

Much of the information which is being obtained in the tobacco research program will be directly applicable to the problems of substitute procedures and materials for steaming, fertilization, and management of plant beds, substitute fertilizer materials and practices in the field, precautions required in cropping practices for maintaining leaf quality in connection with increased production of legumes and other food and feed crops, and the application of simpler methods for control of conditions in curing. A properly balanced fertilizer is essential for best results with tobacco. Since the greater portion of the crop is grown on light soils requiring expensive fertilization, emphasis is being placed on the most effective use of substitutes for standard fertilizer materials now available only in limited quantity. Better methods for control of temperature and humidity in the process of curing are being sought to improve quality and reduce labor requirements.

Nicotine insecticides: Increased demand for insecticides, resulting from increased production of fruits and vegetables, emphasizes the need for additional sources of supply of nicotine for use as an insecticide. This need is accentuated by the acute shortage in the supply of rotenone, and by a shortage in the supply of low-grade leaf tobacco available for extraction of nicotine. At present, nicotine is obtained from tobacco as a by-product. Growing of rustica tobacco, a high-nicotine type, appears to offer one solution of this problem, and special methods of culture which produce large yields have been developed. Culture of this special purpose crop would be of

particular concern to tobacco growers in the dark air-cured and fire-cured areas of Kentucky, Tennessee and Virginia because of the sharp decline in demand for the dark types of leaf. Improved high-yielding varieties of rustica have been developed that are now ready for large-scale trials.

Reducing disease losses: The black shank disease causes exceptionally heavy losses in tobacco production in the southeastern states and is rapidly spreading. Tobacco selections made during ten years of breeding have reached a stage where varieties resistant to black shank and of reasonably good quality will be made available to growers for next year's crop. For control of Granville wilt, which reduces the crop yield by 20 percent in some areas, highly resistant varieties are now being perfected and will soon be ready for the growers. Blue mold requires the planting of 30,000,000 square yards of additional plant-bed area. For control of the disease, sprays which contain copper or other critical war materials are being perfected. Control measures also are being developed for wildfire, mosaic, root rot, and root knot.

Producing tobaccos to meet changing demands: To meet the rapidly increasing demand for the particular grades of domestic leaf required for blending in the manufacture of cigarettes and smoking tobaccos, it is important to keep at a minimum the production of grades which are not suitable for domestic blending purposes but normally would be in demand for export. To accomplish this result, carefully considered adjustments will be required in varietal planting, cultural methods, fertilization, and soil management practices. A new variety, recently released, No. 400, materially simplifies the problem of obtaining easily cured, high quality leaf on the somewhat heavy tobacco soils throughout the Piedmont flue-cured area. In addition, No. 400 is highly resistant to black root rot. Another new variety, No. 401, especially adapted to the Coastal Plain area, will be extensively tried out during the coming year. This variety produces increased yields of cigarette leaf under normal conditions, and also gives high quality leaf when grown on stronger soils under more intensive methods than can be utilized with ordinary varieties.

About 40,000,000 pounds of aromatic tobacco have been imported annually from Greece and Turkey for use in blended cigarettes. Work is under way in the development of new varieties suitable for culture in this country and having the aromatic qualities of the imported Turkish leaf. Because of the extremely small size of the imported leaf, labor costs would be very high in growing the foreign varieties in this country.

(s) TOTAL, SALARIES AND EXPENSES

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this paragraph as follows (deleted matter enclosed with brackets):

Total, salaries and expenses, Bureau of Plant Industry, \$45,192,197, of which amount not to exceed \$1,153,110 may be expended for departmental personal services in the District of Columbia \$4,821,430.

This proposed change in language eliminates reference to the amount for salaries in the District of Columbia, since it is contemplated that

Essentially all personnel of the Bureau of Plant Industry located in the District will be moved during the fiscal year 1943 to the new headquarters of the Bureau near Beltsville, Maryland, in connection with the removal and re-establishment of Arlington Farm. It is expected that, in the fiscal year 1944, less than 20 employees of the Bureau will be located in the District of Columbia, including those at the National Arberetum now classified in the field service, and those at the Federal Plant Inspection House preparing plant introduction and exchange materials for shipment and trans-shipment.

(t) RUBBER INVESTIGATIONS

Second Deficiency Act, 1940 (available until expended) \$500,000
Budget Estimate, 1944 ---

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)
Special rubber investigations:			
Surveys and investigations directed			
toward the development of rubber			
production in the Western			
Hemisphere:			
Bureau of Plant Industry	\$155,865	\$75,000	---
Office of Foreign Agricultural			
Relations	8,765	35,439	---
Total obligations	164,630	110,439	---
1941 balance available in 1942	-275,069	---	---
1942 balance available in 1943	+110,439	-110,439	---
Total appropriation	---	---	---

WORK UNDER THIS APPROPRIATION

Objective: To develop rubber production in quantity in the Western Hemisphere, through breeding disease-resistant, high-yielding strains of the Para rubber tree, Hevea brasiliensis, determining cultural and harvesting practices, and making available to cooperating countries improved strains and methods, thus providing a source of supply relatively close to the United States and aiding indirectly in the establishment of a more complementary, balanced trade between the United States and Latin America.

The Problem and its Significance: Prior to Pearl Harbor about 97 percent of the world's rubber production came from Far Eastern plantations of the Para rubber tree, Hevea brasiliensis, native to the Amazon jungles but taken to European possessions in the East in 1876. The United States used over 50 percent of the total world supply of rubber, and 97 percent of our imports of necessity came from these distant producing areas which now, with the exception of Ceylon and India, are entirely in the hands of the enemy.

Tropical areas of the Western Hemisphere suitable for the Para rubber tree extend from southern Mexico to northern Brazil and Bolivia. This region comprises portions of fifteen Latin American republics representing a great variety of soils, climates, and native populations. In order to effect large-scale rubber production in these areas it will be necessary to overcome the disease hazards to which the Para rubber tree is susceptible, principally leaf blight, and to adapt present methods of rubber production or to develop new methods suited to local population and to local conditions in each area.

Extensive survey data are available about those areas which are considered favorable for rubber production. During the past two years these have been supplemented by actual test plantings to determine the suitability of each district and the adaptability of the leaf-blight-resistant high-yielding clones now being propagated and distributed to interested planters in the selected districts.

Extensive research on the South American leaf blight is under way to determine the effect of climate, altitude, soil, and biologic factors on the severity of the disease. The experimental plantings in cooperation with Latin American countries have indicated the ecological factors which interact to increase or decrease the susceptibility or resistance of the selected rubber strains to this disease, and spraying experiments have already demonstrated control of the disease in the nursery. The experimental plantings serve also as demonstration centers for the encouragement of the small farmer, or individual family-type industry, particularly in the higher labor-cost countries.

Rubber is an important agricultural product which can be encouraged in Latin America with assurance of increasing trade relations and opening up important market outlets for manufactured goods and agricultural products produced in the United States.

General Plan: The work under this appropriation is done principally in Central and South America, in cooperation with the various countries as arranged through the Office of Foreign Agricultural Relations working with the State Department. Desirable coordination of interests among all agencies interested in rubber development in the Western Hemisphere is also maintained through the Office of Foreign Agricultural Relations. The Bureau of Plant Industry is primarily responsible for the technological work done, including surveys, collection, testing, and propagation of planting material; selection and breeding, disease studies, and cultural methods.

Surveys have been made in 15 Latin American countries, and in cooperation with local governmental agencies, actual rubber plantings have been started in 14 of them. Among the many millions of acres of land suited for cultivation of the Para rubber tree, the most favorable districts, considering such factors as accessibility, ownership, density of population, labor costs, and possible financial resources, were selected for these initial demonstration plantings. These plantings vary greatly in character, including nurseries, butwood multiplication gardens, and permanent field plantings, and the number in each country is roughly proportional to the amount of public and private capital thus far attracted to the program. Many millions of seedlings were distributed in the fall of 1942 by this Government for the

establishment of strategically located nurseries to grow seedling stocks for budding with the superior strains in 1943. Approximately 10,000 budded stumps and many thousands of yards of budwood have been distributed for cooperators' use.

An important function of the surveys was to determine the amount and accessibility of wild rubber, mainly Hevea and Castilla, and to locate old plantings of Castilla. In view of the immense areas involved, this feature of the program has been of inestimable value to the Rubber Reserve Company in its purchase program. In connection with increased exploitation of the wild rubber, information on improved methods of gathering latex and preparing the rubber as smoked sheet has been extended to cooperating countries. Examples of shooting machines and other modern equipment for small-scale operations have been supplied to cooperators, with specifications for duplicating the equipment.

Three field stations, mainly supported by this Government, have been established on land and with other facilities furnished by the local Government in each of Costa Rica, Haiti, and Honduras. Specialists have also been assigned for cooperative research at local governmental agricultural stations or institutes in Mexico, Guatemala, Colombia, and Brazil.

The stations in Haiti and Honduras have been concentrated on propagation of the available superior strains and distribution to all cooperating governments. Their location in blight-free areas has permitted the planting of gardens for future breeding and seed production, in which the most productive, but blight-susceptible, strains from the East will be crossed with apparently immune wild selections from the Amazon for the development of rubber trees possessing superior yields and special qualities unattainable in the East with material which originated from a single locality in Brazil.

The cooperative projects in Costa Rica and Brazil have concentrated on solution of the leaf-blight problem and the immediate development of additional strains of the tree which combine superior yield with resistance. This work has been greatly facilitated by the public spirited assistance of American companies having established rubber plantations in these countries. Some 2,000,000 seed from high-yielding Liberian strains were obtained and the seedlings tested for resistance during 1941 and 1942, while more than 2,000,000 additional ones were imported in the spring of 1942 from Brazil for this purpose. Extensive budwood collections from the Amazon have been assembled and are being tested. A small percentage of seedlings from plantation sources are resistant to leaf blight and range high in yield. Some sixty tested selections from the Ford plantations have been propagated as budded strains and distributed to cooperating agencies.

SUPPLEMENTAL FUNDS

The Department of State Appropriation Act, 1943, under the item "Cooperation with the American Republics," authorized the transfer of \$150,000 from that appropriation to the Secretary of Agriculture for continuation in the fiscal year 1943 of surveys and investigations directed toward the development of rubber production in the Western Hemisphere. The Budget Estimates for 1944 contemplate the transfer of \$275,000 for this work in

the fiscal year 1944. A schedule of obligations appears in the printed Budget under the State Department. The item is considered by the Subcommittee on Appropriations for State, Commerce, Justice, and the Judiciary as an important part of the program for cooperation with the American Republics being conducted under the general supervision of the Secretary of State.

SUPPLEMENTAL FUNDS

(not otherwise explained)

Direct Allotments

Project	Obligations: 1942	Estimated obligations: 1943	Estimate obligations: 1944
Special Research Fund:			
Special research projects	\$112,508	\$91,700	\$91,700
Special research laboratories in major agricultural regions	232,490	309,488	309,488
Total, Special Research Fund	344,998	401,188	401,188
Emergency Rubber Project (B.P.I.):			
Investigations directed toward the production of rubber from guayule and other rubber-bearing plants	35,638	398,389	584,000
Conservation and Use of Agricultural Land Resources (B.P.I.): Analysis of fertilizer samples	3,900	6,200	6,200
Working Fund, Agriculture, Plant Industry (Emergency Management):			
Investigations of isotopic separations	4,518	--	--
Castor bean production investigations	440	--	--
Total	4,958	--	--
Working Fund, Agriculture, Bureau of Plant Industry (Advance from Commodity Credit Corporation, Capital Fund): Development of methods of properly caring for grain in storage	2,950	3,000	--

SUPPLEMENTAL FUNDS, Continued

Direct Allotments

Project	Obligations:	Estimated obligations:	Estimated obligations:
	1942	1943	1944
Working Fund, Agriculture, General			
(Bureau of Plant Industry) (Advance from			
salaries and expenses, Board of Economic			
Barfare): Investigations to determine			
Cinchona resources in Colombia and in			
connection with the establishment of a			
bark collection program	--	1,533	--
Working Fund, Agriculture, General			
(Bureau of Plant Industry) (Advance from			
Emergency Fund for the President)			
(Allotment to State): Cooperation with			
the Chinese Government in the study of			
agricultural problems	---	4,309	---
TOTAL, SUPPLEMENTAL FUNDS (Direct			
allotments)	392,444	814,619	991,388

PASSENGER-CARRYING VEHICLES

As indicated in the statement of passenger-carrying vehicles in the estimates, the Bureau of Plant Industry does not contemplate the purchase of any new passenger-carrying vehicles during the fiscal year 1944. It is expected that 173 old vehicles will remain in use.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

(a) GENERAL ADMINISTRATIVE EXPENSES

Appropriation Act, 1943.....	\$160,000
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Office of the Administrator, Agricultural Research Administration".....	-2,000
"Salaries and expenses, Library".....	-12,300
Total available, 1943.....	145,700
Budget estimate, 1944.....	<u>138,420</u>
Decrease.....	<u>-7,280</u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. General administration and business service.....	\$154,462	\$145,700	\$138,420	-\$7,280
Unobligated balance	610	- -	- -	- -
Total estimate 1944 and compara- ble amounts 1943 and 1942.....	\$155,072	145,700	138,420	-7,280

DECREASE

(1) The decrease of \$7,280 in this item for 1944 is due to the discontinuance of the Bureau's photographic laboratory in the District of Columbia and a curtailment in the general administrative offices.

WORK UNDER THIS APPROPRIATION

Objective: To determine policies and provide leadership and direction for the Bureau's program as well as to provide for service activities such as business operations, and educational work.

The Problem and its Significance: In an organization with so large and broad a subject matter field as the Bureau of Entomology and Plant Quarantine, it is essential that policies be established on a broad basis and that there be proper over-all direction and supervision of the various work programs. It is also necessary to provide service facilities through units having a knowledge and appreciation of the work of the various subject matter divisions so as to enable them to deal intelligently with the problems encountered in their respective fields. Inadequate planning or execution in connection with any of these functions would have a retarding effect on the operations of the Bureau in general and could seriously handicap working programs of vital concern to the agricultural interests of the country.

General Plan: The funds provided under this appropriation are used for general administrative purposes comprised of the following functions: (a) determination of policies; (b) general administrative supervision of all departmental and field activities; (c) business operations; (d) the approval and preparation for publication of manuscripts concerned with the scientific, technical and other activities of the Bureau; (e) the preparation and distribution of general information on control of insect pests; and (f) the handling of general information relating to federal quarantines and the preparation of cases on quarantine violations.

SUPPLEMENTAL FUNDS

Direct Allotment

Project	Obligations 1942
Emergency Relief Appropriation Act of 1941 and 1942:	
For administration of emergency work relief projects set forth	
under the various headings in the following notes and summarized:	
at the end hereof.....	71,670
For planning and review of W.P.A. projects.....	3,510
Total.....	75,180

(b) FRUIT INSECTS

Appropriation Act, 1943.....	\$408,630
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Office of the	
Administrator, Agricultural Research	
Administration".....	-4,000
Total available, 1943.....	404,630
Budget estimate, 1944	383,920
Decrease (including decrease of \$500	
travel fund returned to surplus).....	-20,710

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Investigations on:				
1. Insects affecting deciduous fruits.....	\$189,483	\$190,386	\$175,176	-\$15,210
2. Citrus and other subtropical fruit insects.....	39,222	42,644	42,644	-
3. Fruit flies which are poten- tial pests in continental United States.....	69,471	68,716	63,716	-5,000
4. Japanese beetle.....	103,375	102,384	102,384	-
Covered into Treasury in accordance with Public Law 674.....	- -	500	- -	-50
Unobligated balance.....	26,769	- -	- -	-
Total estimate 1944 and compara- ble amounts 1943 and 1942	428,320	404,630	383,920	-20,710

DECREASE

The decrease of \$20,710 in this item for 1944 consists of \$500 decrease in travel funds (returned to surplus in 1943) and:

- (1) A decrease of \$15,210 for deciduous fruit insect investigations which contemplates discontinuance of work on pecan insects at Albany, Georgia, and Brownwood, Texas.
- (2) A decrease of \$5,000 for investigations on fruit flies which are potential pests in the continental United States, involving a curtailment of work being done in Hawaii.

WORK UNDER THIS APPROPRIATION

Objective: To develop means whereby the growers of fruits and nuts can control insect pests more effectively or more economically, thus increasing the net returns from their operations and insuring the armed forces and the consuming public an ample supply of fresh and dried fruit of high quality. In addition, to develop methods whereby home owners may protect their plantings from attack by Japanese beetle; to develop methods whereby the movement of various agricultural products from areas infested by the Japanese beetle to uninfested territory may be made without danger of spreading the insect; to stimulate to the fullest possible extent the parasites and diseases which tend to control the Japanese beetle. In the case of the Parlatoria scale, to obtain a thorough understanding of the biology and host plant relations of this pest and to develop adequate methods for controlling it and for preventing it from becoming more widely disseminated.

Problem and its Significance: Fruits and nuts are crops of major importance in the United States, the farm value of some of the more important of which were reported in 1940 as follows: Citrus fruits, \$120,000,000; apples, \$94,000,000; peaches, \$43,000,000; grapes, \$45,000,000; pears, \$21,000,000. The value of fruits in a well balanced national diet is receiving increasing recognition, especially during the present national emergency, and it is essential that an adequate supply of fruit be available to the armed forces and the consuming public.

All of the fruit crops are subject to serious attack by insect pests. Some of the major annual losses, including the cost of control measures, have been estimated as follows: Codling moth, \$31,000,000; plum curculio, \$10,000,000; San Jose scale, \$7,380,000. Many growers of apples spend 50 to 60 dollars per acre for codling moth control, and some citrus growers spend even more for fumigation and other measures for the control of scale and other pests. Next to freezes and other unfavorable weather conditions, destruction of crops by insect pests is the most likely to prevent the attainment of production goals, which for 1942 were 100% of normal for fresh fruits and 119% of normal for dried fruits. Insecticide shortages, threatened and actual, make necessary the modification of standard control recommendations and the development of information on substitute materials for war limited insecticides.

Losses by the Japanese beetle are difficult to estimate on a financial basis, since a great deal of damage occurs to shade trees, ornamental shrubbery, and in flower gardens, where the injury does not represent a reduction in the owner's income. However, a WPA survey made in 1934 indicated a loss of nearly a million dollars to growers of farm crops in one New Jersey county alone. This means that this one insect must cause a total damage to crops over the entire infested area of many millions of dollars.

General Plan: The research work on fruit insects is carried on at 23 field laboratories, which are maintained at suitable locations, mostly in the producing areas where the particular insect problem to be investigated is especially serious. Much of the work is cooperative with State Agricultural Experiment Stations or other State agencies, and in several cases is carried on cooperatively by two or more divisions of this bureau.

The investigations on fruit insects are now carried on under four financial projects, a revision and simplification of the financial project structure, which was formerly divided into nine projects.

Examples of Progress and Current Program: The discussions which follow will indicate the present trend of the work under the respective projects and will outline briefly some of the recent accomplishments. Statements on the work carried on under the project covering investigations of insects affecting deciduous fruits are grouped to show the work under way with insects affecting the various fruit crops.

Investigations of Insects Affecting Deciduous Fruits:

Apple and Pear Insects: Attention is still being given to the codling moth problem in an effort to develop an insecticide or other means of control less objectionable with regard to the amount of poisonous residue left on the fruit, more effective and more readily obtainable during the present emergency than lead arsenate.

In continued field tests at several points, a micronized phenothiazine again control of the codling moth about equal to that obtained with lead arsenate. regular material, which has a greater particle size, gave much poorer result. In certain cases the phenothiazine, especially the micronized form, had some adverse effect on color and in a few instances it retarded ripening and reduce size of the fruit.

A new formula for a tank-mix nicotine bentonite combination was developed by Vincennes, Ind. laboratory. This formula includes a cheap, low-swelling Mississippi clay in place of Wyoming bentonite, and mineral oil in place of bean oil. It gave good control of the codling moth under experimental conditions and had the further advantage of leaving very little visible residue on the fruit, thus overcoming one serious disadvantage of the highly effective tank-mix material prepared with Wyoming bentonite and soybean oil.

Xanthone used against the codling moth by the Yakima, Wash. laboratory left fruit considerably wormier than lead arsenate, and its use in the early cover sprays caused some russetting of the fruit. Xanthone was found to have some effect in the control of orchard mites in the Northwest. In the Middle West and East Xanthone was definitely less effective in codling moth control than lead arsenate.

Among the several hundred insecticide materials given preliminary testing at Beltsville, Md. during the year were a few which warrant further study, including an alkaloid isolated from a Chinese plant known as the "Thunder God Vine". A discovery was also made at the Vincennes, Ind. laboratory that certain soybean phosphatides could be used in small quantities with various oils to produce mixtures with good deposit-building properties.

The study of the scale insect, Parlatoria chinensis, at St. Louis, Mo. shows that this insect had two complete generations and a partial third during 1941. Evidence has been obtained that both crawlers and adult males of this scale can be disseminated by air movement. Summer oils at strengths of 2 to 3 percent killed a high percentage of all stages, and dormant-type oils at 4 percent likewise gave a high kill.

From experiments conducted as a basis for the control program against the pear psylla, it was determined that an oil of approximately 200 viscosity could be used on pear trees in the Northwest at a concentration as high as 10 percent without dormant spraying with no detrimental effect on the trees other than a temporary slowing up of the spring development. The usual strength is 3 or 4 percent.

New infestations of the Comstock mealybug have been found in orchards of Connecticut and New Jersey. Five species of parasites introduced from Japan have now been colonized in certain orchards of Virginia, West Virginia, Ohio, Georgia, New Jersey, and Connecticut. One species, known as Allotropa sp. #1, survives winter conditions very well at several of the original colonization points in Virginia, West Virginia, and Ohio, and has attained a rapid build-up and spread in several of the orchards. A second species, Pseudophycus sp., has also demonstrated the ability to increase rapidly under orchard conditions, although it is severely attacked by several species of native secondary parasites. Both of these introduced species are now well established at several localities, the colonization is being extended as rapidly as practicable.

Peach Insects.-Considerable progress has been made at the Moorestown, N.J. laboratory in the development of methods for breeding parasites in large numbers for mass liberation against the oriental fruit moth in peach orchards. In a breeding cage over 1/10 acre of strawberry infested with the strawberry leaf roller, an alternate host, the adults of the parasite Macrocentrus ancylivorus were produced at the rate of 630,000 per acre, a quantity sufficient for mass liberations in about 1,200 acres of peach. It is planned to further improve on rearing methods in order that the project may be in position to supply information, and possibly a rearing stock of both hosts and parasites, to cooperating State agencies so that they may carry on the final rearing work to produce parasites for liberation within their respective States. Further experiments in the mass liberation of parasites have continued to demonstrate that a substantially lower average injury to the fruit occurs in orchards receiving parasites than in those not receiving them.

Continued investigations of reports of injury to peach trees attributed to ethylene dichloride used against the peach tree borer has disclosed that winter injury was the chief cause of damage at various points in Georgia, South Carolina, and North Carolina. Observations revealed excellent control of this insect in those States with no tree injury. Continued experiments with the use of ethylene dichloride emulsion conducted at Beltsville, Md. in cooperation with the Bureau of Plant Industry showed that the emulsion should not be poured directly on the trunk of the tree and that the danger of injury is increased when the chemical is applied to wet soil late in the season.

In experiments at Beltsville, Md. and at Fort Valley, Ga., propylene dichloride emulsion was found to give equal, if not better, control of the peachtree borer at a strength 5 percent weaker than the recommended strength of ethylene dichloride emulsion, with no tree injury.

Continued efforts at the Fort Valley, Ga. laboratory to develop a satisfactory substitute for lead arsenate for control of the plum curculio on peach indicated that two applications of dichloro-ethyl ether emulsion to the soil under the spread of the peach trees, with jarring to catch overwintered adults, are just as effective against this insect as the regular lead arsenate spray program.

Surveys in connection with the possible insect transmission of peach virus diseases were continued. In peach orchards where the phony peach disease occurs, 1,299 lots of insects were collected at 47 stations in 36 localities in 13 States. In orchards where the peach mosaic disease occurs an estimated 4,725 accessions were added to the records from 34 sampling stations in 7 States.

The testing work to determine which insects, if any, transmit these peach virus diseases, is being continued. During 1941 and in the spring and summer of 1942 the Brownwood, Texas, and San Bernardino, Calif. laboratories carried on 2,114 transmission tests, the total tests to date at the two laboratories being 4,817.

During the same period at East Chattanooga, Tenn. transmission tests were made with 286 lots of insects suspected of being possible vectors of the phony peach disease but first readings cannot be made until 1943. Preliminary transmission tests have also been made with insects suspected of being possible vectors of the western "X" disease and of the peach rosette. Thus far no insect has been definitely shown to be capable of transmitting any of these diseases, the indications a year earlier pointing to certain aphids not having been confirmed.

Grape Insects.-In large-scale experiments to develop substitutes for lead arsenate for the control of the grape berry moth in the Lake Erie grape belt, a combination spray schedule of arsenicals in the early sprays, followed by processed nicotine bentonite, again gave better results than an all-season program of nicotine bentonite. A micronized phenothiazine was superior to the standard material and was highly effective in control. A hooded spray boom which permits spraying in fairly windy weather was used in the grape-spraying experiments in 1941 and proved quite satisfactory. Observations are being continued to determine the value of cultural practices as supplements to spraying for control of the grape berry moth.

Nut Insects.-Further experiments in the cultural control of the hickory shuckworm on pecan by burying the fallen nuts through cultivation with a disk-tiller have continued to give favorable results at Albany, Ga. A combination spray of lead arsenate, nicotine sulfate, and summer oil in experiments in Texas to control the pecan nut casebearer gave a yield of nuts 2 to 3 times greater than from trees sprayed with lead arsenate alone. During recent years the pecan weevil has assumed greatly increased importance. A survey in 1941 showed infestations in Texas in which an average of 64 percent of the crop in some orchards was destroyed by weevils, and serious infestations were observed in Georgia in 1942.

In 1941 more than a three-fold increase was observed in a number of filbert orchards in the Northwest suffering commercial loss of 10% or more from attack by the filbert worm. Although normally only one generation of this insect occurs in a year, a second generation has been noted in a few instances while some individuals were found to have a 2-year life cycle on filbert nuts, oak acorns, and hazelnuts. Further studies of varietal susceptibility carried on in filbert orchards have largely confirmed previous results indicating that the Daviana, Bollwyler (Hall's Giant) and the Barcelona varieties are most susceptible to filbert worm attack.

Dried Fruit Insects.-The urgent need for ample supplies of dried fruits for military needs has led the modification of the program to include studies on improved packaging for insect protection and on fumigation of military supplies. Experiments by the Dried Fruit Insect Laboratory at Fresno, Calif. to determine the feasibility of protecting stacks of stored boxed raisins from infestation by the saw-toothed grain beetle by the use of barriers, have indicated that the preliminary cleaning of the protected raisins, which ordinarily removes about 90 percent of the infestation from the common seedless variety (Sultanina), was inadequate since the residual infestation was great enough to permit considerable increase. Therefore, the raisins used in the protected stack in new experiments under way have been fumigated with methyl bromide.

Tests to determine the effect of refrigeration of dried fruits on insects attacking them revealed that adults of the saw-toothed grain beetle and full-grown larvae of the Indian-meal moth succumbed when held at 32°F. for 22 and 23 days, but full grown larvae of the raisin moth were not all killed after 125 days.

Investigations of Citrus and Other Subtropical Fruit Insects: Improvements have been made in the blower applicator for introducing and circulating hydrocyanic acid gas under the tent in fumigation for the control of the California red scale and other scale insects of citrus. Tests indicate that this applicator as now designed will give immediate distribution of the gas in

in the tent under varying field conditions, resulting in a more consistent control of the scale. However, uniform peak concentrations are not always obtained and further tests, including a study of tent fabrics better adapted to retain the gas, are being carried on.

In laboratory tests a stock of the California red scale very resistant to fumigation with hydrocyanic acid was subjected to a series of ten fumigations during a period of over 2 years, and although the resistance of survivors increased following the first three or four fumigations, the survivors of later fumigations showed no further increase in resistance. In several other stocks obtained from the field and similarly treated, the resistance increased, supporting the preliminary conclusions that field populations are mixtures of resistant and nonresistant scales and that repeated fumigations tend to eliminate the nonresistant scales.

In general, sublethal dosages of HCN prior to final treatment reduced the kill of both resistant and nonresistant strains of red scale, the decrease being more pronounced in the resistant scales. The protective stupefaction produced by sublethal dosages differed with different developmental states of the scale and reacted differently at various temperatures. Further tests, both in the laboratory and field, are necessary to obtain a better understanding of this complicated problem.

Tests with derris and cube resins in oil for the control of the California red scale have shown that the addition of 0.57 percent of derris resin to a tank-mix oil increased the toxicity of the spray. Higher concentrations of resins produced no further increase in kill in the tank-mix oil, although increases in kill, with increases of derris resins up to 1.06 percent, had been shown with "emulsive" oils. The results obtained by citrus growers with the derris and cube resins in oil have been rather variable and further work is needed. However, for the present attention is being given to toxicants other than derris and cube since rotenone-bearing materials are no longer available for use in the spraying of citrus.

Field experiments to control the citrus thrips on lemons in southern California have indicated that tartar emetic spray is more effective than sulfur dust and that 2 applications of the spray, properly timed, would give at least as good protection to fruit and foliage as 5 applications of sulfur dust. However, in certain orchards a decided resistance of the citrus thrips to this spray has developed, toward the end of the third year of commercial use of the spray and during which period about 30 generations of the insect probably developed and were exposed to the tartar emetic residues. Investigations to determine the reasons for this resistance to the poison and to develop other and more satisfactory methods of control have been started. Preliminary tests have shown that a nicotine-sugar spray is toxic to the citrus thrips when freshly applied but that it has no residual effect and permits rapid reinfestation.

Continued work by the St. Lucie, Fla. laboratory with several types of oil against various scale insects on citrus included two highly refined oils and two lower grade oils. At 1-1/4 percent oil strength in the spray mixture, the kills of all four oils were low. However, one of the lower grade oils was

somewhat more effective in killing purple and Florida red scales on grapefruit trees than were any of the other oils tested. It would appear that the cheap red oils are more practical under Florida conditions than the more expensive white oils.

Further experiments in Florida to determine the influence of cover crops on the abundance of the citrus rust mite have given inconclusive results and additional tests are under way.

Investigations of Fruitflies Which are Potential Pests in

Continental United States: The objectives of this project are to develop (1) knowledge and methods of control for species of fruitflies that threaten Continental United States agricultural industries by introduction, and (2) methods for treating fruits and vegetables to permit these to move safely in the regular channels of trade throughout the United States if infestation should be discovered in any part of the States.

Investigational work is carried on in regions where the fruitflies are established. Laboratories are at present maintained in Hawaii, Mexico City, and in the Canal Zone. Work in Puerto Rico and in southern Texas has been closed recently after attaining its principal objectives. The work in Mexico is conducted in cooperation with the Mexican Government, which has provided laboratory and other facilities and is keenly interested in the research underway. Methods of treatment of tropical fruits which would insure their freedom from infestation without damaging the fruit are being developed. Work has been directed toward recognition of different species, study of their habit, length of life, migratory tendencies, economic importance, and methods of control in the field. These investigations will serve as a basis for allowing tropical fruits which we cannot produce economically to enter this country without endangering our agriculture through introduction of the pest. It tends to help the regions involved in their problems of fruit production and marketing, and builds up international good will.

Refrigeration experiments have shown that holding fruit at a moderate degree of cold not injurious to the fruit (34° - 35° F.) for a period of about 2 weeks destroys all fruitfly stages that may be present. A vapor-heat treatment by saturated air, with a moderately high temperature (110° F.) for 8 hours more has been shown to destroy fruitfly stages without injury to the fruit. These processes lend themselves well to commercial handling. Some details need further work and the application to various species must be tested. Apparatus has been devised for rather exactly reproducing in the laboratory the temperatures of our northern winters, so that potential dangers from several of the fruitflies may be tested in the Mexico City laboratory. A species which affects peaches in northern Mexico and is a potential danger to us is being studied. It is susceptible to sterilization methods developed for other species. Work of determining responses to temperature, which may help in differentiating species and indicating the potential danger from different forms, has been carried through in the case of the peach-infesting species. Similar work on other fruitflies should be carried out. Progress has been made in the field of spraying with antimony compounds for the destruction of adults of the Mexican fruitfly. Procedure and interpretation of vapor-heat treatments has been carefully studied and some improvements made in the method and adaptations to other problems. Improvements have been made in the use of traps for capturing adult fruitflies which will help in studying abundance

habits, and effect of control procedures. The work in Hawaii has been modified to meet urgent war problems, including methods of control of fruitflies and other insect pests of local food crops and by acting in an advisory capacity to civil and military authorities on various pressing insect problems.

Investigations of the Japanese Beetle: The milky disease has given striking evidence of its value in the control of the grubs of the Japanese beetle. In parts of Washington, D. C., where intensive colonization of the disease organisms has been made during the past two seasons, the grub populations dropped from 20 to 50 grubs per square foot in August 1941 to 9 grubs or less per square foot in early June 1942. The former high adult beetle infestation in the treated areas was very much reduced in 1942, and the grub population did not exceed 8 grubs per square foot in October.

The program of the distribution of the milky disease has been continued in order to accelerate the natural spread and from the results obtained thus far it is anticipated that this work should within a few years result in a material reduction in the Japanese beetle infestations where the disease has been placed. Through 1942, 6,211 acres of infested turf had been treated by the Bureau on 91 Governmental reservations in Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, and the District of Columbia. Cooperation was also extended to State agencies in Maryland, Delaware, Pennsylvania, Connecticut, and Rhode Island in the production of the milky disease material for local use. In cooperation with these States and the States of Massachusetts, New Jersey, New York, North Carolina, Ohio, Virginia, and West Virginia, a total of 29,227 acres have now been treated at 42,098 colony locations in 205 counties of the area infested by the Japanese beetle.

The Japanese beetle has continued to spread at about the usual rate. In 1942 the generally infested area joined with the extensive previously isolated infestations in the lower Eastern Shore of Maryland and Virginia. A noticeable increase in density of beetles occurred in southern New England.

A total of 34 materials and combinations have been tested at the Moorestown, N. J. laboratory with the object of developing more satisfactory sprays for use against the adult beetles and to develop substitutes for the materials ordinarily used, many of which are critical war materials and are now extremely scarce or entirely unavailable. In preliminary tests, both the tetramethyl thiuram mono- and disulfides, at 6 pounds per 100 gallons, appeared nearly equal to lead arsenate as a Japanese beetle repellent, and micronized phenothiazine at the rate of 2 pounds per 100 gallons, with bentonite, was equal in repellent effect to the standard lead arsenate spray.

Studies of substitutes for geraniol, which has recently been difficult to obtain for use as an attractant for Japanese beetle traps, were continued. The work thus far has indicated that anethole might be substituted weight for weight for the geraniol and pimento oil for the eugenol used in the standard bait without decreasing its attractiveness. Studies to develop non-metallic substitutes for the metal traps in present use are also under way.

Research is being continued with a view to permitting modification in the methods prescribed for the treatment of nursery stock or other farm products to permit safe movement outside the infested area. Studies of the use of paradichlorobenzene for the treatment of balled or potted nursery plants furnished further information regarding a definite post-fumigation residual effect and have permitted a reduction in the required treatment period. Tests with ethylene dichloride emulsion showed that this material was unusually effective in freeing balled or potted nursery stock from infestation by the beetle when the plant balls were dipped in the emulsion. As a result of this work the quarantine requirements have recently been modified to authorize the use of such treatment.

Studies of the resistance of soybean varieties to feeding by the Japanese beetle are being continued in an area of heavy infestation. In cooperation with the Division of Japanese Beetle Control, viological assays are being conducted to determine the initial quantities of lead arsenate needed for soil treatment in isolated infestations, and to determine changes in the effectiveness of lead arsenate in soils that have been treated.

Preliminary studies of poisons other than lead arsenate for soil treatment have shown that mercurous chloride and mercuric chloride are highly toxic to newly hatched larvae. Further tests with these materials are in progress to determine the tolerance of grasses to these compounds.

(c) JAPANESE BEETLE CONTROL

Appropriation Act, 1943	\$382,275
Budget estimate, 1944	<u>360,120</u>
Decrease (including decrease of \$3,200 travel funds returned to surplus)	<u><u>-22,155</u></u>

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Japanese beetle control operations:				
(a) Supervision of nurseries and greenhouses for Japanese beetle control	\$192,381	\$188,356	\$184,401	-\$3,955(1)
(b) Scouting adjacent to nurseries and greenhouses for Japanese beetle control	31,166	31,000	31,000	- -
(c) Trapping to determine distribu- tion of the Japanese beetle	66,856	60,000	45,000	-15,000(2)
(d) Soil treatment and trapping in isolated areas to aid in prevent- ing spread of the Japanese beetle	38,934	29,275	29,275	- -
(e) Farm products inspection for Japanese beetle control	21,966	22,000	22,000	- -
(f) Vehicular inspection for Japanese beetle control	56,096	30,000	30,000	- -
(g) Transit inspection for Japanese beetle control	7,000	7,000	7,000	- -
(h) Tests of treatment required for Japanese beetle control	11,500	11,444	11,444	- -
Covered into Treasury in accordance with Public Law 674	- -	3,200	- -	-3,200
Unobligated balance	1,906	- -	- -	- -
Total estimate or appropriation ...	427,805	382,275	360,120	-22,155

DECREASE

The decrease of \$22,155 in this item for 1944 consists of \$3,200 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$3,955 for the project "Supervision of nurseries and greenhouses for Japanese beetle control," which contemplates a reduction in the number of seasonal employees engaged in inspection of nurseries and greenhouses in the regulated area.

(2) A decrease of \$15,000 for the project "Trapping to determine distribution of the Japanese beetle," which contemplates a reduction in the number of seasonal employees assigned to trapping operations in areas throughout the country where efforts are being made to determine whether the Japanese beetle occurs in isolated infestations.

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of the Japanese beetle to sections of the United States as yet uninfested and to facilitate under proper safeguards the movement from infested to uninfested areas of fruits and vegetables and other plant products and articles which may carry infestation.

The Problem and its Significance: The Japanese beetle is highly destructive to a wide variety of plants used for food, forage and ornamental purposes. The beetle is now well established in areas where there is large scale growing of important food crops and other plants, a considerable amount of which is distributed throughout the United States. However, there are other large food producing areas of this country where the beetle is not yet known to occur. The problem then is to protect the latter from infestation by the insect, and at the same time avoid serious disruption of the shipment of fruits and vegetables and other products from the areas already infested. It is particularly important that the work be conducted properly since in the absence of effective Federal regulations non-infested states might enforce local requirements which could interfere seriously with the prompt delivery of perishable products, or might even place embargoes on importation of articles capable of carrying infestation.

General Plan: The area under regulation on account of the Japanese beetle includes parts of Maine, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Maryland, West Virginia, and Virginia, and all of Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, and the District of Columbia. There must be supervision and inspection to insure the proper treatment and handling of products restricted by the quarantine. There must also be a regular survey of premises to determine the status of infestation so that correct measures (either piece by piece inspection and treatment, or general permit certification) may be adopted in each case. In addition, points in non-regulated territory considered as likely to be infested by the insect are surveyed through the use of traps, and isolated infestations discovered are dealt with either through quarantine or through arrangements with those interested for cooperative control. Vehicular inspection stations are maintained on major high-

ways and arrangements are made for truck, railroad, airplane and mail inspection or treatment of materials as needed. Efforts also are made in cooperation with research units of the Bureau to develop new, safe, and inexpensive treatments of plants and plant products to permit them to meet the requirements of inspection and certification. Practically every State in the regulated area furnishes active cooperation, and the total contribution for the fiscal year 1943 from such sources amounts to more than \$275,000.

Examples of Progress and Current Program: Work under this appropriation is divided into the projects discussed below:

Supervision of nurseries and greenhouses: This work includes the inspection or treatment of nursery, ornamental and greenhouse plant materials where infestation by the Japanese beetle exists in the vicinity so that the products may be certified for movement to the non-regulated area. The area under regulation now comprises approximately 122,700 square miles (as compared with 43,000 square miles in 1930). More than 3,600 commercial establishments are involved (compared with 1,600 in 1930), and a number of individuals likewise ship the restricted products. From stations established at central points inspectors visit the various establishments served.

During the fiscal year 1942, approximately 700 square miles were added to the quarantined area and some additional establishments were placed under regulation. Soil removal or chemical treatment certification became necessary in 142 newly infested premises within the area. The inspection service certified nursery and related products for movement with an estimated value above \$11,000,000, and at the peak 240 inspectors were employed, including both Federal and State officers.

Scouting adjacent to nurseries and greenhouses: This work involves the scouting of establishments not known to be infested by the Japanese beetle but within the regulated area as a basis for permitting certified shipment without actual inspection or treatment of the product. The Japanese Beetle Quarantine provides for the certification of restricted materials on an annual basis from uninfested premises within the regulated territory. To determine whether these establishments are infested or free, the premises and the area within 500 feet of each must be surveyed several times during the flight period of the insect for its presence. There are about 1,200 establishments at this time requiring this service.

Trapping to determine distribution of Japanese beetle:

Soil treatment and trapping in isolated areas to prevent spread of

Japanese beetle: The trapping work included in these two project titles consists of making, distributing and tending traps which capture Japanese beetles. During the past summer (1942), in order to

locate possible new infestations, 64,000 traps were placed and operated outside the regulated area in the following 19 states: Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, Maryland, Kentucky, Tennessee, Maine, Vermont, New York, Pennsylvania, Ohio, Indiana, Illinois, Michigan, Wisconsin and Missouri.

Trapping for control was carried on in conjunction with treatment of soil with lead arsenate at isolated infestations in New York, Ohio, Indiana, Illinois, Michigan, Missouri and North Carolina. This was done in cooperation with the state or other local governmental agencies.

When an infestation of the Japanese beetle is found in a new locality at some distance from the region under regulation the new area represents another source for spread as well as another place for population increase and damage. In these circumstances, an opportunity is offered the State or other interested agency to control the insect in cooperation with the Federal Government and without necessarily having Federal quarantine restrictions invoked.

The value of control work in isolated areas is indicated by the fact that infestations in areas treated in Missouri, Illinois, Indiana, Ohio, Michigan, Georgia, North and South Carolina, Virginia and Kentucky have been reduced or have not developed to a significant degree although some have been known to exist for seven or eight years. During the fiscal year 1942 approximately 1,000 acres were treated at isolated infestations in the following states: New York, Ohio, Indiana, Illinois, Michigan, Missouri and North Carolina.

Farm products inspection for Japanese beetle control: This work includes inspection and certification necessary to meet quarantine requirements during the flight season of the Japanese beetle. Operations are carried on in Delaware, District of Columbia and in parts of Maryland, New Jersey, Pennsylvania and Virginia at points from which quantities of perishable fruits and vegetables are shipped throughout the Eastern third of the United States and to Canada. In 1942 considerable quantities were shipped under certification to Army and Navy bases and to war production areas. These products must be moved promptly and with a minimum of handling. Fumigation furnishes a means of providing the necessary certification within the limits of time and safety, and during the 1942 season a total of 2,924 refrigerator cars loaded with fruits and vegetables was fumigated with methyl bromide.

During the fiscal year 1942 more than 1,800,000 packages of fruits and vegetables were certified for transportation to non-infested sections of the United States and Canada.

Vehicular inspection for Japanese beetle control: This work involves the establishment of highway and airport inspection points where vehicles and products moving out of the regulated area may be examined

and freed from infestation. The inspection points are established where risk of spread seems greatest on main highways leading South and West from the regulated region. To conserve funds, all stations are operated on a seasonal basis confined to the period when danger of transportation of infestation is greatest. The system of operation was changed during the latter part of the fiscal year 1942 when there was a considerable decrease in motor vehicle travel because of rubber and gas shortages. Since then we have operated on a system of spot checking motor trucks on all the important roads, using a smaller number of mobile inspectors. Likewise, during the summer some stationary 24-hour inspection posts were established for the inspection of restricted products.

At the commercial airports of Washington, D. C., and New York City, inspection was carried on during the summer in cooperation with field and airline officials. In addition, during the 1942 season inspectors examined planes departing from the Glenn Martin factory near Baltimore, Maryland, and the Floyd Bennett field on Long Island. The Secretaries of War and Navy cooperated by instructing operators of service aircraft to inspect planes departing from airports in the regulated areas to ascertain that no beetles were being carried to destinations beyond.

During the fiscal year 1942, 9,300 motor vehicles transporting uncertified quarantined articles were intercepted.

Transit inspection for Japanese beetle control: This work project consists of a check maintained on shipments by way of parcel post, freight and express to ascertain compliance with the Japanese Beetle Quarantine regulations.

Tests of treatments: This work is designed to provide means of developing new and improved treatments of products, movement of which is restricted under the Japanese Beetle Quarantine, and of testing the efficacy and operation of the treatments under practical conditions. The aim of such treatments is to produce eligibility of the products for certification in the simplest manner and at a minimum of cost to the Federal Government and the shipper.

During the past three years, this work has resulted in steady progress. Specific accomplishments are the development of fumigation using methyl bromide, the expansion of the schedules of treatments to include different temperatures and conditions, the determination of the safety factor in the fumigation of many products, and the development of plans for approved, inexpensive, safe and well constructed fumigation chambers.

In the fiscal year 1942 a practicable treatment with ethylene dichloride was developed and approved. Already this chemical treatment has had wide application and further tests are in progress to widen its scope.

(d) SWEETPOTATO WEEVIL CONTROL

Appropriation Act, 1943	\$71,585
Budget estimate, 1944	67,770
Decrease (including decrease of \$250 travel funds) ..	<u>-3,815</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase decrease
1. Sweetpotato weevil control .	\$68,654	\$71,335	\$67,770	-\$3,565
Covered into Treasury in ac-				
cordance with Public Law				
674	- -	250	- -	-250
Unobligated balance	2,171	- -	- -	- -
Total estimate or				
appropriation	70,825	71,585	67,770	-3,815

DECREASE

The decrease of \$3,815 in this item for 1944 consists of \$250 decrease in travel funds (returned to surplus in 1943) and:

- (1) A decrease of \$3,565 which contemplates a reduction of control activities in the States of Texas, Louisiana, and Mississippi.

WORK UNDER THIS APPROPRIATION

Objective: To cooperate with State agencies in the eradication of the sweetpotato weevil from commercial sweetpotato plantings in areas where such eradication of the insect is practicable, and the protection of areas in which eradication has been accomplished by the enforcement of the regulatory measures provided in the standard state quarantines promulgated on account of this pest.

The Problem and its Significance: In 1940, sweetpotatoes produced in the United States had a farm value of over \$52,000,000, and over 41% of these were grown in the States of Alabama, Georgia, Louisiana, Mississippi, and Texas. In these states, the outstanding sweetpotato pest is the sweetpotato weevil. The control and eradication of this pest is, therefore, of major importance in order that sweetpotatoes may continue to be produced profitably. In addition, increased production of this source of food and livestock feed is particularly essential at this time, as it

provides an important food for the armed services and civilian populations of this and allied nations, as well as an important source of starch, demands for which have been increased by the War and the curtailment of importations of starch and materials from which it is derived.

General Plan: Activities designed to accomplish control and eradication of the weevil include (1) inspection to locate and determine the status of the weevil in commercial sweetpotato-producing areas; (2) operations to eradicate the pest from infested plantings wherever such measures are applicable; (3) the destruction of infested seed beds and storage banks; (4) cleaning up of fields after harvest; (5) eradication of wild host plants, where practicable; and (6) cooperation with states in the enforcement of regulatory measures. Cooperating states are donating \$80,800 to this program during the fiscal year 1943.

Examples of Progress and Current Program: Since the beginning of federal-state cooperative control work in July, 1937, 188 counties or parishes in the six States of Alabama, Arkansas, Georgia, Louisiana, Mississippi, and Texas have been surveyed. Infestations were found in 42 counties or parishes in the five States of Alabama, Georgia, Louisiana, Mississippi, and Texas. The survey work in Louisiana has been restricted to those parishes in close proximity to the eradication areas in other states or outside the area in that state considered as generally infested and in which eradication is at the present time deemed impracticable. Thirty-seven counties or parishes have been included in the area in which eradication work is being done, 7 having been added during the last fiscal year. Eradication has apparently been accomplished in 21 counties in Alabama, Georgia, Mississippi, and Texas, leaving a total of 21 counties in which eradication work is now being conducted. During the fiscal year 1941 the eradication areas consisted of 30 counties in 4 states, Alabama, Georgia, Mississippi, and Texas, in which area eradication had apparently been accomplished on 1257 properties and in 18 entire counties, leaving 12 infested counties in the eradication area. Because of this excellent progress, 7 other counties and several parishes in Louisiana were added to the eradication areas in 1942. Only 400 new infestations were reported during the fiscal year 1942, which, with the carryover from previous years, leaves a total of 437 properties now under quarantine in the eradication areas of the above-mentioned 5 states. Eradication was apparently accomplished in 3 additional counties in Mississippi during the fiscal year 1942. Inasmuch as eradication of the sweetpotato weevil cannot be accomplished by farmers working individually because of the spread from one farm to another and over long distances by shipments of sweetpotatoes and propagating plants, it is necessary that a coordinated effort be made by government agencies. The eradication of local infestations in commercial-producing areas is of utmost importance to the sweetpotato industry.

It is planned to continue intensive reinspection of areas in which eradication has been accomplished to discover any possible reinfestations and to continue the inspection and eradication efforts in those counties in

which the insect has apparently not been completely eradicated. In addition, cooperation with the states will be continued in the enforcement of state quarantines to prevent the movement of material from infested areas which might carry the insect to non-infested areas.

(c) MEXICAN FRUITFLY CONTROL

Appropriation Act, 1943	\$163,740
Budget estimate, 1944	155,320
Decrease (including decrease of \$250 travel funds returned to surplus)	-8,420

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Mexican fruitfly control operations:				
(a) Grove and packing-house inspection and certification for Mexican fruitfly control	\$145,512	\$149,990	\$141,820	-\$8,170
(b) Spraying and control of Mexican fruitfly in Mexico	5,000	5,000	5,000	-
(c) Vehicular inspection for Mexican fruitfly control	8,500	8,500	8,500	-
Covered into Treasury in accordance with Public Law 674	-	250	-	-250
Unobligated balance	10,643	-	-	-
Total estimate or appropriation	169,655	163,740	155,320	-8,420

DECREASE

The decrease of \$8,420 in this item for 1944 consists of \$250 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$8,170 in the project "Grove and packing-house inspection and certification for Mexican fruitfly control," which contemplates the discontinuance of the services of approximately 12 employees during the three-month period when this work is least active.

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of Mexican fruitfly from those parts of Texas along the Mexican border where it occurs and cooperate with appropriate official agencies to control existing infestations, thus protecting uninfested fruit producing regions from this important pest of many kinds of fruits.

The Problem and its Significance: The Mexican fruitfly is an insect that seriously damages citrus, deciduous and certain tropical fruits in Mexico, where it probably originated. This pest was discovered in Texas in 1927, and infestations of varying degrees of intensity have been found almost every year since that date. During some seasons it has caused important loss to citrus fruit in the Lower Rio Grande Valley of Texas. Within the past few years citrus production within this area has reached a total of between forty-five and fifty thousand carloads annually, and the presence of this pest is an important economic factor. The problem is to protect as far as possible the quality and marketability of this crop, and through the enforcement of Federal Quarantine No. 64, to prevent the spread of this serious fruit pest from the regulated area in Texas to other fruit growing regions of the United States.

General Plan: The general work plan is (1) by periodic grove and field inspections, to determine the presence or absence of the Mexican fruitfly; (2) by inspection of citrus packing and processing plants to insure that fruit being packed, processed, or shipped will be moved in accordance with quarantine regulations; (3) to maintain a host-free period during the summer months so that no ripe fruits are in the area, preventing oviposition and resultant increase in the fly population; (4) to route fruit from infested groves through sterilization rooms so that any living larvae in the fruit will be destroyed; (5) to inspect markets and groves in Mexico adjacent to the regulated area in Texas with the object of holding down infestations which could easily spread to Texas groves; (6) to control the movement of citrus fruit by motor vehicles through operation of road traffic inspection stations at strategic points.

The work is organized under three projects: (1) Grove and Packing House Inspection and Certification; (2) Spraying and Control in Mexico; and (3) Vehicular Inspection.

Examples of Progress and Current Program: During the 1941-42 shipping season for citrus fruits, outbreaks of the fruitfly were very light, which made it possible to again extend the shipping season to May 31, one month beyond the usual closing date, although there was very little fruit remaining on the trees to be shipped during the month of May. Fruitflies trapped numbered 244, and larval infestations discovered were 259, the lowest since the season of 1937-38.

The vapor heat method of sterilization authorized under the quarantine regulations continued to be used, but on account of the relatively light fruitfly infestation the amount of fruit treated by vapor heat was only 35% of the amount treated the previous season. Only 3619 tons of fruit were diverted to sterilization rooms before packing, compared with 9936 tons the previous season. No fruit was sterilized by the low temperature method.

Two road stations were operated during the 1941-42 season, the amount of fruit inspected being equivalent to 9700 carlots, compared with 15,700 carlots during the previous shipping season. This reduction in shipment by truck was influenced by a reduction in freight rates, as well as the tire and truck situation caused by war conditions. Facilities at both road stations were extended to the Border Patrol of the Department of Justice in carrying out certain phases of its work.

(f) CITRUS CANCKER ERADICATION

Appropriation Act, 1943	\$10,160
Budget estimate, 1944	<u>9,650</u>
Decrease	<u>-510</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Citrus canker eradication ..	\$13,263	\$10,160	\$9,650	-\$510
Unobligated balance	322	- -	- -	- -
Total estimate or appropriation	13,585	10,160	9,650	-510

DECREASE

(1) The decrease of \$510 in this item for 1944 contemplates a curtailment in the inspection of citrus-growing properties in the State of Texas.

WORK UNDER THIS APPROPRIATION

Objective: To cooperate with responsible State agencies in locating and eradicating any remaining infections of citrus canker which may occur within the United States, thus eliminating a serious introduced disease and protecting the citrus industry from excessive losses that may result. The seriousness of this disease and the magnitude of losses to the industry which may result therefrom has been demonstrated in areas from which it has been eradicated.

The Problem and its Significance: Citrus canker is a destructive, introduced bacterial disease which attacks all parts of the tree, including fruit, making it unmarketable. The disease is highly infectious and can easily spread from tree to tree in many ways, including the use of tools, movement of domestic animals, birds, et cetera. It may be spread long distances by movement of infected parts of the citrus trees, including fruit and through shipments of nursery stock.

The disease known as citrus canker was first found in the United States in the vicinity of Port Arthur, Texas, in 1911. It spread rapidly eastward reaching several counties in Florida in 1914 and causing important losses in certain commercial producing areas. Extensive activities carried on in cooperation with Federal and State agencies involving the expenditure of approximately \$5,000,000 resulted in eradicating the disease from Alabama,

Georgia, Florida, Mississippi, and South Carolina, and all other commercial citrus producing areas. In this work several hundred thousand orchard and nursery trees were destroyed and the participating States, as well as private industry, made large contributions to the work. The disease is believed to still persist in noncommercial sections in limited parts of Louisiana and Texas. The present problem consists of locating and eradicating any infections that may exist to complete the task of eliminating this important introduced disease from the United States.

Production of citrus fruit is an important industry with an annual average farm value in excess of \$120,000,000. Its protection from the ravages of this destructive disease is essential to the welfare of the industry which furnishes a food product necessary to the general health and well-being of the nation.

General Plan: (1) To reinspect commercial citrus producing areas in Louisiana and Texas for incipient infections and recurrences of the disease; (2) to inspect citrus growing nurseries for the prevention of possible dissemination of diseased nursery stock; (3) to complete intensive reinspection of all escaped and planted host trees of the disease in noncommercial citrus areas in Louisiana and Texas where infections occurred recently; and (4) to destroy all infected trees and all abandoned and escaped host trees in their vicinity and in the environs of previous infections. The States of Texas and Louisiana are contributing to this program during the fiscal year 1943.

Examples of Progress and Current Program: To give added needed assurance that the disease does not reappear in Florida, annual inspections are made, independently, throughout the citrus area in that State by the responsible State agency.

Since 1935 several million wild and abandoned host plants of no commercial importance, growing on infected properties and in their vicinities, have been destroyed by cooperation with property owners and under State authority by relief labor employed under funds allotted for emergency relief. This accomplishment has resulted in elimination of a reservoir which might harbor infection and from which the disease might spread.

Intensive inspections during the past several years clearly indicate that the citrus canker disease persists in limited noncommercial citrus producing areas in Louisiana and Texas; that the disease is being eliminated from such areas is indicated by the fact that no infections have been found since February, 1941, when infections were found on nine properties in two counties in Texas, whereas infections were found on one hundred properties during the previous six years. Unless all remaining infections are located and eradicated, they will be centers from which the disease will spread to valuable commercial plantings in these and other citrus producing States.

SUPPLEMENTAL FUNDS

Direct allotment

Project	Obligations, 1942
Emergency Relief Appropriations: Citrus canker eradication	\$20,501

(g) GYPSY AND BROWN-TAIL MOTH CONTROL

Appropriation Act, 1943	\$382,570
Budget estimate, 1944	363,060
Decrease (including decrease of \$400 travel funds returned to surplus)	<u>-19,510</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Inspection and certification for gypsy and brown-tail moth control	\$98,880	\$101,770	\$101,770	-
2. Control operations for gypsy and brown-tail moths	275,632	280,400	261,290	-\$19,110
Covered into Treasury in accor- dance with Public Law 674 ...	- -	400	- -	-400
Unobligated balance	3,898	- -	- -	-
Total estimate or appropriation	378,410	382,570	363,060	-19,510

DECREASE

The decrease of \$19,510 in this item for 1944 consists of \$400 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$19,110 in the project "Control operations for gypsy and brown-tail moth control." This decrease contemplates curtailment of operations in the Barrier Zone to the extent of \$12,000 and outside the Barrier Zone in the amount of \$7,110. This saving will be realized principally through the curtailment of personal services.

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of the gypsy and brown-tail moths by artificial means by safeguarding the movement of articles which may carry the

pests into uninfested areas; and to suppress the gypsy moth at the margin of the generally infested area to prevent its spread into new sections by natural means and to eradicate outlying infestations.

The Problem and its Significance: The gypsy moth and brown-tail moth are important introduced pests which have become established in the New England area. Both are vigorous defoliators feeding upon a wide variety of trees and causing a great damage. The problem is, through the use of active control measures and quarantine, to keep the insects within the general area in which they occur and to prevent spread to uninfested areas, and at the same time to make intensive efforts to reduce populations in the area of general infestation, particularly in regions adjacent to uninfested areas. Important interests are affected by this problem because (1) the commercial and aesthetic value of the trees to be protected is very large, and (2) articles affected by the quarantine include nursery stock, stone and quarry products, and forest products, including Christmas trees and greenery. Inadequate control and inspection measures would endanger the values in the former group, and would almost certainly result in state embargoes on the part of states now free from these pests.

General Plan: Inspection and certification service is maintained from strategic points throughout the State of Rhode Island and parts of Maine, New Hampshire, Vermont, Massachusetts and Connecticut, which comprise the regulated area. In Pennsylvania a State quarantine similar to the Federal gypsy moth quarantine is enforced in the infested area cooperatively by the Federal and State organizations. A barrier zone is maintained at the western edge of the generally infested area in which intensive scouting and control work is carried on in order to locate and destroy incipient infestations and minimize the chance of a spread to the uninfested areas to the west, and to eradicate incipient infestations which may have become established in uninfested areas. This work has been carried on under both regular appropriations and allotments under W.P.A. funds, and active cooperation has been received from state, county, and municipal agencies which are contributing during the fiscal year 1943 a total of more than \$1,000,000.

Examples of Progress and Current Program: The work under this appropriation is conducted under two separate projects--(1) Inspection and certification for gypsy and brown-tail moth control and (2) control operations for gypsy and brown-tail moths.

The situation under these projects is outlined as follows:

Inspection and certification for gypsy and brown-tail moth control: There has been no important change in the area under regulation for the past four years, although there has been an appreciable increase in the requests for inspection and certification service. The following trends have been noted: (1) Tremendous increases in the demand for inspection and certification of lumber to be used in war industries. Much of the lumber is cut from logs placed in water storage following the New England hurricane of 1938. Many of the lumber storage piles are in locations subject to moth infestation. (2) Development of methyl bromide fumigation for Christmas trees and probably eventual extension of this method of treatment for all carload lots of forest products. Authorization of fumigation for Christmas trees, it is anticipated, will eventually result in the lifting of the present embargo on the movement of Christmas trees from

the heavily infested area and in the ultimate increased demand for certification of Christmas trees from the entire infested area. Since 1938 there has been a general and steady increase in quantities of products offered for inspection and certification. For example, lumber inspections that totaled 34,997,628 board feet in 1938 and 89,000,000 board feet in 1940 increased to 240,189,700 board feet in 1942.

Control operations for gypsy and brown-tail moths: For the duration of the war the objective of the project activities is to protect accomplishments already obtained and to prevent spread until more extensive surveys and eradication practices can be resumed. Current efforts are directed to two major activities, namely, intensive control measures in the case of the most dangerous and threatening infestations in the barrier zone area and the eradication of outlying infestations including the serious one in Pennsylvania. Intensive scouting of woodlands is carried on in the infested section of Pennsylvania and in isolated points of infestation in New York State where eradication is the ultimate objective. Less intensive surveys also are conducted in and near the western margin of general infestation in the New England-New York area to locate infestations which represent an appreciable hazard of spread. Such infestations are controlled by destroying the egg clusters by treating them with creosote or by spraying the foliage with insecticides to kill the caterpillars. Demonstrations have shown that insecticides can be applied on forest tracts with autogiros and airplanes so rapidly and economically than is possible with ground spray equipment. It is planned to stress the aerial method of control in subsequent seasons. Special emphasis is given to a method of survey to locate outlying infestations by the use of material attractive to male gypsy moths. Approximately 3,000,000 acres were surveyed by this method during the past summer. During the year scattered infestations were located by this method of survey in the Albany-Schenectady area of New York and eradication work in cooperation with that state is under way in accordance with a mutually approved work program. During the fiscal year 1942 W.P.A. work was greatly reduced. Such a decrease in funds and labor previously available for gypsy moth activities has necessitated a revision in survey and control procedure.

SUPPLEMENTAL FUNDS

Direct Allotment

Project	Obligations, 1942
Emergency Relief Appropriations: Control and prevention of spread of gypsy moth	\$199,258

(1) DUTCH ELM DISEASE ERADICATION

Appropriation Act, 1943	\$356,475
Proposed transfers in 1944 estimates to	
"Salaries and expenses, Office of the Adminis- trator, Agricultural Research Administration"	-4,000
Total available, 1943	352,475
Budget estimate, 1944	333,330
Decrease (including decrease of \$1,600 travel funds returned to surplus)	-19,145

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Dutch elm disease eradi- cation:	:	:	:	:
(a) Scouting to locate the Dutch elm disease	\$256,295	\$259,530	\$244,530	-\$15,000 (1)
(b) Identification of dis- ease in trees suspected to be infected with the Dutch elm disease	25,320	25,320	25,320	- -
(c) Enforcement of quar- antine on Dutch elm disease	9,184	10,175	10,175	- -
(d) Coordination of State work on the Dutch elm disease	25,325	25,325	25,325	- -
(e) Removal of diseased, dead and dying trees ...	10,172	10,175	10,175	- -
(f) Investigations and surveys on virus disease of elms prevalent in the Ohio Valley	20,350	20,350	17,805	-2,545 (2)
Covered into Treasury in ac- cordance with Public Law 674	- -	1,600	- -	-1,600
Unobligated balance ;.....	5,199	- -	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	351,845	352,475	333,330	-19,145

DECREASE

The decrease of \$19,145 in this item for 1944 consists of a \$1,600 decrease in travel funds (returned to surplus in 1943) and:

- (1) A decrease of \$15,000 for the project "Scouting to locate the Dutch elm disease," which contemplates a reduction in seasonal employees engaged in scouting, principally in New York, New Jersey, Connecticut, and Massachusetts
- (2) A decrease of \$2,545 for the project "Investigations and surveys on virus disease of elms prevalent in the Ohio Valley," contemplating a decrease in work in that area.

WORK UNDER THIS APPROPRIATION

Objective: To suppress, to prevent the spread of, and where practicable to eradicate, an introduced and destructive fungus disease, known as Dutch elm disease, and to conduct control investigations on an important virus disease of elm prevalent in the Ohio River Valley, thus protecting elms of the country.

The Problem and its Significance: The Dutch elm disease is caused by a fungus to which all elm species are susceptible and for which there is no known curative treatment. In the light of present knowledge, the fungus is carried to healthy trees and to new areas by bark beetles which develop in elm in which the disease organism occurs.

From the discovery of the Dutch elm disease in Ohio in 1930 to November 30, 1942, over 65,300 elms affected by the disease have been located. Diseased trees have been found in a major region involving parts of New Jersey, New York, Connecticut, Pennsylvania, and Massachusetts. In addition, outlying isolated disease centers have been found in Ohio, Maryland, Indiana, Virginia, West Virginia, New York, and Pennsylvania. The elms in 13 other states have been exposed to the disease through the movement of imported elm burl logs that were infected or are threatened by spread from established areas.

The elm virus disease, which is prevalent in the Ohio River Valley, has killed many elms in various sections of that region, but its great destructiveness seems to have been somewhat localized.

The American Elm which is generally accepted as this country's most important shade tree, is susceptible to attack and death by the Dutch elm disease. It has been estimated that there are over 25,000,000 elm shade trees in the United States and that the real estate value of the shade trees alone exceeds \$660,000,000. This figure does not include the timber, cordwood, and other conservation values of farm and forest elms. Furthermore, the elms of America have values which cannot be measured in dollars; such as value for sentiment or historical reasons, and for special size and beauty. The death of American elms would be a serious community loss, and would mean the destruction of an irreplaceable national asset. Their death would develop a tremendous cost through the necessity of removing millions of elms from along highways, streets and roadways and from lawns and parks, as a personal safety and property protection measure.

General Plan: The work on the Dutch elm disease consists of: (1) scouting for diseased and carrier beetle infested material in known and possibly infected areas, (2) identifying the disease organism by laboratory culture tests,

(3) destroying diseased and beetle infested material before it becomes a source of spread, and (4) endeavoring to restrict the transportation of diseased material from infected to uninfected sections of the country.

Appropriations to the Department as well as allotments of W.P.A. funds have been used, but the work has been largely financed from W.P.A. funds. The work is conducted in cooperation with and is supported by State funds in varying amounts in States where the disease has been found. During the fiscal year 1943, the financial support by all States amounted to about \$140,000.

Examples of Progress and Current Program: On October 1, 1941, the major region of known infection included 10,637 square miles, involving the northern half of New Jersey, southeastern part of New York, western half of Connecticut, southwest corner of Massachusetts, and eastern part of Pennsylvania. During the summer of 1942, this region was increased to about 12,500 square miles. During 1941 and 1942, due to lack of funds and to a growing shortage in capable employees the work in the center of the major region was limited largely to Control Areas selected by officials of cooperating states generally on the basis of the elm values involved. A Border Zone of about 9,000 square miles around the major region was scouted as thoroughly as funds and personnel would permit. The diseased trees found and a large amount of beetle material were removed in this Border Zone. More thorough scouting and removal work was done in and about the isolated infection areas in Ohio, Maryland, Indiana, West Virginia, New York, and Pennsylvania. Light survey work was done in areas around Boston, Mass. and Rochester, N. Y. as well as in the Potomac and Ohio River Valleys where the carrier beetles occur.

During the fiscal year 1942, a total of 2,067 diseased trees were found among the 21,056 specimens cultured in the Laboratory. The numbers of specimen collected and diseased trees confirmed are about half the numbers for the fiscal year 1941. During the first five months of fiscal year 1943, a total of 1,059 diseased trees were found among 7,516 specimens cultured. Because of the nature of the work during the coming seven months of the fiscal year these figures will probably not be materially increased. The smaller number of diseased trees found does not necessarily indicate an improved condition, but is more evidently a reflection of the reduced amount of scouting within the major region where the disease is known to occur.

During the fiscal year 1942, the size of the major region increased about 1,300 square miles, and an additional 500 square miles were added during the completed part of fiscal year 1943. This increase carried the area into the southwest corner of Massachusetts, an evident extension of the disease from adjoining New York and Connecticut. No serious extensions were made this year by the finding of long established isolated centers. The increase seems due to current or recent spread found through more emphasis being placed on work in the Border Zone during the summers of 1941 and 1942.

After a lapse of four years, a diseased tree was found in Baltimore, Md. during the summer of 1941. One diseased tree was found at Old Lyme, Conn. in

1942 after a similar lapse of four years. These finds are evidence that areas must be worked for years after the last disease is found. The known disease area centered around Athens, Ohio was extended into West Virginia, as shown by the finding of a diseased tree on the south side of the Ohio River.

The eight months, from October 1941 through May 1942, were devoted largely to sanitation work aimed at reducing the population of the beetle carrier of the disease. Some suspect scouting was done at the time beetle material was tagged for removal. Special survey work was done in the Ohio Valley and upper New York State. During the fiscal year 1942, 85,258 trees and items were eradicated and beetle material was removed from 13,955 trees. This is only 44% as great as last year's results, but the material was better selected. The transfer of all W.P.A. projects to State operations and the eventual closing out of W.P.A. work drastically reduced the amount of sanitation work that could be done.

The program for the present (fiscal year 1943), and for the/national emergency, is aimed at maintaining some of the important progress already made by reducing the rate of spread of the disease to new territory and by holding down the rate of loss of valuable elms in the disease area. Keeping track of the distribution of the disease is not only necessary to current operations but is highly important for any future action. A continuation of the eradication effort is considered the most practical way of handling the outlying centers where the conditions are favorable.

Control of spread of the disease at the border of the major region will require considerable work because the margin is 500 miles in length and the work zone should be from 10 to 20 miles deep. Suppression work in the Control Areas of the major region will give some protection to many valuable elms as well as contribute to reduction of spread at the edge of the Region. Improvement in methods of operation is considered of great importance in obtaining maximum results from limited man power. An attempt is being made to develop a scouting force to work on a year round basis. Beetle material is being cultured as a means of early detection of the presence of the Dutch elm disease fungus in an area. Some diseased trees that are not an immediate menace, and can be pruned more economically than entirely removed, are left standing. The methods used and results obtained by research workers and by local agencies engaged in control efforts are being carefully studied for possible wider use.

SUPPLEMENTAL FUNDS

Direct Allotment

Project	:	Obligations,
	:	1942
Emergency Relief Appropriations: Eradication of	:	
Dutch elm disease	:	\$621,201

(i) PHONY PEACH AND PEACH MOSAIC ERADICATION

Appropriation Act, 1943.....	\$92,190
Budget estimate, 1944.....	<u>87,090</u>
Decrease (including decrease of \$520 travel funds returned to surplus).....	<u><u>-5,100</u></u>

PROJECT STATEMENT

Project	1942	1943	1944	Increase or decrease
		(estimated)	(estimated)	
1. Eradication of phony peach and peach mosaic.....	\$89,529	\$91,670	\$87,090	-\$4,580 (1)
Covered into Treasury in accordance with Public Law 674.....	--	520	--	- 520
Unobligated balance.....	1,341	--	--	--
Total estimate or appropriation	90,870	92,190	87,090	-5,100

DECREASE

The decrease of \$5,100 in this item for 1944 consists of \$520 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$4,580 which contemplates the curtailment of orchard inspection work in the States of North Carolina, Tennessee, and Missouri, which are on the edge of the general area of infestation.

WORK UNDER THIS APPROPRIATION

Objective: To cooperate with state and local agencies in suppressing and if possible eliminating and in preventing the spread of phony peach and peach mosaic, two destructive virus diseases of peaches.

The Problem and its Significance: Production of peaches is an important industry in 40 states, with an average annual farm value in excess of \$50,000,000. These diseases dwarf trees, reduce production, and render fruit of little economic value. More than 49,000 orchard trees were found infected with these diseases in 1942. Their habit of natural spread from tree to tree, from orchard to orchard, and over long distances through the medium of nursery stock shipments places their control beyond the ability of individual growers.

General Plan: In cooperation with states, to inspect host trees; to provide for removal of those found infected; to inspect nurseries and budwood sources and their environs, and certify those nurseries found free of disease; to enforce state quarantines, and to remove escaped and abandoned

host trees to prevent their becoming reservoirs for these diseases. During the fiscal year 1943, cooperating states are donating approximately \$24,200 to phony peach eradication and \$28,125 to peach mosaic eradication.

Examples of Progress and Current Program: Protection is being afforded to the peach industry within the limit of available funds. Elimination of WPA fund without any provision being made in lieu thereof, has necessitated substantial readjustment in the control and suppression program resulting in very considerable curtailment of activities in important areas.

All commercial peach-growing nurseries in the infected areas, comprising more than 400, which grow in excess of 12,000,000 trees were inspected, and with the exception of three nurseries, all of these met the certification requirements of the standard state quarantines relating to these diseases, thus making their stock safe and eligible for interstate movement. This accomplishment precludes the hazard of artificial spread of these diseases to new or cleaned-up areas.

During the year, two additional states, Kentucky and North Carolina, on the periphery of the main infestation, were determined upon inspection to be free from the phony disease. Several counties in the lightly infected states were cleaned up. Thus, six whole states and more than 150 counties in other states have apparently been freed of these diseases since 1935.

The program followed for the past several years is predicated on (1) protection of nurseries by rigid annual inspections to prevent local or long-distance spread of the diseases to new or cleaned-up areas through the medium of nursery stock; (2) eliminating the last traces of the diseases from counties or states in which only light infections remain; (3) protection insofar as practicable, commercial areas in order to permit economic peach production and to reduce and ultimately eliminate the disease from such areas.

The work under (1) above was satisfactorily completed in 1942, and activities under the other two items were prosecuted vigorously within the limit of available funds. Curtailment of work previously carried on under WPA funds has retarded progress in removing diseased trees. At the end of October, 1942, diseased trees remained standing in Alabama to the extent of 8,000, Georgia 16,000 and Texas 400 phony trees, while in California 320, Colorado 1,000, and in Texas 2,200 mosaic infected trees had not been removed. A program of this sort is much more effective if diseased trees are removed promptly as they are found.

For similar reasons there has been a decrease in the inspection of infected commercial areas. In 6 of the main producing counties in Georgia, in which 4,300,000 trees were inspected in 1941, only 1 1/4 million trees were inspected in 1942. There was a comparable reduction in other areas, such as Spartanburg County, South Carolina, growing more than 4 million trees.

In a considerable number of counties in lightly infected periphery states a limited amount of work was done in 1942 towards a final inspection of previously infected and adjacent properties.

SUPPLEMENTAL FUNDS

Direct Allotments

Project.	:	Obligations,	:
	:	1942	:
Emergency Relief Appropriations:	:		:
Control of phony peach disease.....	:	\$64,438	:
Control of peach mosaic disease.....	:	55,969	:
Total.....	:	120,407	:

(i) FOREST INSECTS

Appropriation Act, 1943.....	\$199,680
Budget estimate, 1944.....	189,700
Decrease.....	<u><u>-9,980</u></u>

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PROJECT STATEMENT

Project:	1942	1943 :(estimated):	1944 :(estimated):	Increase : decrease:
1. Investigations on forest insects:				
(a) Investigations of insects attacking mature timber and development of control methods	\$46,300	\$46,000	\$41,000	\$ - 5,000
(b) Investigations of insects attacking plantations and second growth timber and development of control methods....	60,200	46,000	41,020	- 4,980
(c) Investigations of insects attacking forest products and the development of control methods.....	8,000	10,180	10,180	--
(d) Investigations of termites and the development of control methods.....	23,000	31,000	31,000	--
(e) Investigations of insect vectors of forest tree diseases and development of control methods for these vectors.....	19,050	15,200	15,200	--
(f) Surveys to locate and determine the status of insect pests on Federal and private forest land and the formulation of advice to the land managing agencies on planning and conducting necessary control work.....	49,159	51,300	51,300	--
Unobligated balance.....	8,956	--	--	--
Total estimate or appropriation	214,665	199,680	189,700	- 9,980

DECREASE

The decrease of \$9,980 in this item for 1944 consists of:

(1) A decrease of \$5,000 under the project "Investigations of Insects Attacking Mature Timber and Development of Control Methods", which contemplates a curtailment of work on bark beetles and other insects in the forest areas of the western United States.

(2) A decrease of \$4,980 under the project "Investigations of Insects Attacking Plantations and Second-Growth Timber and Development of Control Methods," which contemplates a curtailment of gypsy moth investigations being conducted at New Haven, Connecticut.

WORK UNDER THIS APPROPRIATION

Objective: To devise the most effective and economical methods of preventing or controlling insect damage to forest trees and forest products, especially those that are of critical importance in the war effort; to make surveys to determine the status of insect infestations and ascertain where control programs are needed; to advise forest-managing and wood-using agencies on control methods and aid them with technical advice and supervision.

The Problem and its Significance: Insects affecting forests and forest products are estimated to cause losses in excess of \$100,000,000 annually. This destruction is of particular importance at present because of the greatly increased demands for lumber and other forest products used to meet war demands. Our reserve supply of standing timber and the tremendous quantities cut for lumber and other purposes must be protected from insect attack.

Losses caused by forest insects are much smaller than they would be if it were not for the assistance given to forest-managing agencies and wood-using industries. War time construction activities, particularly of the Army and Navy have developed many new problems and accentuated several of those already under study and for which reasonably effective preventive or control measures have been developed.

General Plan: The work is organized on a regional basis with 10 field laboratories each of which gives attention to the most important research and service problems of its surrounding area. Emphasis is placed upon active cooperation with other federal, state and private agencies. Studies that will not result in information of immediate practical application are being curtailed for the present. The funds and personnel so released are being devoted to problems that affect the supply of commercial timber needed for war uses. This has resulted in active cooperation with many other federal agencies such as the War and Navy Departments, several branches of the National Housing Agency, Reconstruction Finance Corporation, and Lend-Lease Administration.

Examples of Progress and Current Programs: The work under this appropriation has been considerably modified during the past year in order to place the greatest possible emphasis on investigations which will give immediate aid in our war effort. The work has been directed into those activities having to do with (1) conservation of timber resources and increased production of lumber; (2) cooperation with the federal housing agencies and the War and Navy Departments and War Production Board by giving advice on prevention of termite damage to housing construction and to wood substitutions for metals for use in the Tropics; and (3) with efforts to improve and make more effective the work of certain large control programs, such as the gypsy moth and Dutch elm disease projects. Other activities have been held in abeyance or reduced to a mere maintenance basis so as to not lose all that has been put into them heretofore.

The interest manifested by federal and private timberland owners in the so-called sanitation-salvage logging of trees susceptible to insect attack in the mature ponderosa pine stands of eastern California and Oregon has not only been maintained but increased applications of this method have been put into effect during the past year. The method has been particularly adaptable to the present demand for increased lumber production stimulated by war needs. These high risk trees, which are selected for cutting, yield a higher percentage of the lower grades used by war industries and at the same time the reserve stands are protected from bark beetle epidemics. As a result stands will be left in a more productive condition and a larger supply of high grade lumber will be available to meet the postwar market. Additional studies were conducted during the year and are being continued in appraising the value and relative importance of the tree characters indicative of high susceptibility to beetle attack. The success of this system depends on making available practical marking rules, which can be readily applied by foresters in the employ of federal and private agencies.

Bark beetle detection surveys, which serve as the basis for recommendations for insect control work to administrators of national forests, national park and Indian lands as well as private companies, were continued as usual. Approximately 16 million acres were covered in general observational surveys and about 150,000 acres of sample plots were intensively cruised. The bark beetle situation has, in general, continued to improve during the last two years and control was recommended in only a very few areas of the central Rocky Mountain region, particularly in northern Utah and in southern California on Forest Service lands used intensively for recreational purposes. In northern Utah, on the Ashley, Wasatch and Uinta National Forests, a bark beetle outbreak in lodgepole pine shows a marked reduction, following the application of a relatively new method of treatment, which was first tried on a large scale in these forests. The trees are felled and the trunks sprayed with a mixture of 5 parts light fuel oil and one part orthodichlorobenzene. Complete control was obtained and it was possible to carry the work right through the hazardous summer fire season.

The demand for information on preventing termite damage increased rapidly as the nation entered into an all-out war effort, due, largely to the increasing use of wood substitutions for metal materials. Frequently the specialists of this Bureau are called upon by the War Production Board and Army and Navy engineers to answer questions regarding the resistance of certain woods to termites and the most satisfactory methods of preserving the life of such woods in different parts of the world, with and without chemical treatment. This information has been coordinated with that provided by the Forest Service on timber physics and that furnished by the Bureau of Plant Industry pathologists on decay. The drawing up of specifications for large wooden storage tanks for gasoline to be placed under ground in tropical countries well illustrate the effectiveness of joint efforts on these problems. At a two hour conference among representatives of these various agencies, it was possible to decide on the physical requirements of the wood needed to meet the army specifications and to obtain reasonable safety from termite or decay hazards for a period of 5 to 10 years. During the past year contacts with engineers and

architects of the federal housing agencies have continued and inspections of plans or actual construction have been carried out in all parts of the country where termites are a menace.

As a result of intensive laboratory work, the use of metal termite shields is being discouraged. Shields have been found to be unreliable without annual inspections. The simple flat type of shield is just as effective as the generally used shield which projects horizontally for 2" and is then bent downward at a 45 degree angle for 2". This old type of shield is very difficult to install effectively. Thus, metal is saved and equally good protection is obtained through improved design of the structures except under extreme conditions.

Two laboratories - one at New Haven, Connecticut, and one at Morristown, New Jersey, have been handling research work designed to increase the effectiveness of 2 large control projects of this Bureau - the gypsy moth and the Dutch elm disease control programs. The reduced funds available for these control programs make it increasingly imperative that the money available be used effectively, therefore these laboratories have devoted more time to these activities. In the gypsy moth work attention has been directed to developing substitute insecticides for lead arsenate, which is becoming very critical, and also to the possibility of applying insecticides over forested areas at much less expense through the use of aircraft instead of the usual ground machines and miles of hose.

Considerable effort has been centered around the development of synthetic material for trapping the gypsy moth. The present material in use is extracted from the adult females and the supply is strictly limited. A synthetic compound would permit tremendous expansion in the territory surveyed each year to determine whether or not the gypsy moth is spreading into areas beyond the barrier zone.

Important advancements were reported last year in the control and trapping of the vectors of the Dutch elm disease. It was found that beetles spreading Dutch elm disease could be effectively trapped by the injection of a chemical combination, consisting of sodium chlorate and sodium arsenite, or sodium fluoride, into elm trees of little value. This treatment not only attracted the beetles but killed all those entering the tree. Further large tests in the field have shown the practicability of this method. It also should serve as a very inexpensive method of scouting for the disease, as such trap trees located outside the known diseased area can be examined and some of the trapped beetles removed and tested for the presence of the fungus. This technic offers a possible gain of a year or more over detection by the usual symptoms of withered branches and dying trees.

(k) TRUCK CROP AND GARDEN INSECTS

Appropriation Act, 1943.....\$324,020
 Budget estimate, 1944..... 307,340
 Decrease (including decrease of \$500
 travel funds returned to surplus)..... -16,680

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Truck crop insect investi- gations.....	\$238,819	\$230,255	\$230,255	--
2. Berry insect investigations	5,980	--	--	--
3. Tobacco insect investiga- tions.....	70,963	62,765	56,415	\$ -6,350
4. Insects affecting green- house crops and bulbs..	42,248	30,500	20,670	-9,830
Covered into Treasury in accord- ance with Public Law 674...	--	500	--	500
Unobligated balance	11,515	--	--	--
Total estimate or appropriation.....	369,625	324,020	307,340	-16,680

DECREASE

The decrease of \$16,680 in this item for 1944 consists of \$500 decrease in travel funds (returned to surplus in 1943) and:

- (1) A decrease of \$6,350 on the project "Tobacco insect investigations" involving the closing of the station at Quincy, Florida.
- (2) A decrease of \$9,830 on the project "Insects affecting greenhouse crops and bulbs" which contemplates the discontinuance of bulb insect investigation at Babylon, Long Island, and Sumner, Washington.

WORK UNDER THIS APPROPRIATION

Objective: To increase returns to growers of vegetables, including sugar beets, tobacco, and greenhouse crops and bulbs by devising safe, simple, and practical methods at a minimum cost for controlling the insects and related pests which attack these crops in the field and in storage.

The Problem and its Significance: Vegetables, including sugar beets, tobacco, and greenhouse crops and bulbs, comprise a very important part of agriculture in the United States, reaching a total estimated farm value exceeding two and one-half billions of dollars in 1940.

The need for increased production of vegetables and other food for our own use as well as that of our Allies and a shortage of insecticides necessitates modifications and improvements in existing insect control practices, including (1) the development of effective insecticides of domestic origin to supplant those of foreign origin which have been cut off because of war, or which are needed in the production of essential war materials; (2) the prevention of losses both in quantity and quality of crops due to insect damage; (3) the safeguarding of the health of the consumer through the elimination of harmful insecticidal residues and (4) the profitable production of crops where climatic and agronomic conditions are suitable, but where insect depredations are limiting factors.

General Plan: The work consists in its preliminary stages of field and laboratory experiments and later of commercial operations in the field in cooperation with State Agricultural Experiment Stations, State Departments of Agriculture, other Bureaus of this Department, growers, various industries and similar groups. Work is in progress in a total of 17 States, 4 of which are located in the Pacific Northwest (Washington, Oregon, Idaho, and Utah), 2 States in the Southwest (California and Arizona), 3 States in the Middle West (Ohio, Wisconsin, Nebraska), 6 States in the South (Louisiana, Florida, South Carolina, North Carolina, Virginia, and Tennessee) and 2 States in the Northeast (Maine and Maryland).

The work is organized under three Projects, covering investigations on insects and related pests attacking (a) vegetable crops and sugar beets, (b) tobacco, and (c) greenhouse crops and bulbs.

Examples of Progress and Current Program: The following examples of recent contributions to the service of agriculture under this appropriation are cited in order to give a background of the broader aspects of the problems:

Truck crop insect investigations: In the late 1920's and early 1930's the problem of insecticidal residues on leafy vegetables became acute because of the injudicious use by some growers of arsenicals in their attempt to control outbreaks of insect pests on such crops as cabbage, lettuce, celery and beans. Experience had shown that poisonous residues could not be removed from these vegetable products by the ordinary washing process. Emphasis was placed, therefore, on the elimination of this hazard to the consumer and crop losses to the grower.

Work on this problem led to the development, on a regional basis, of insecticides and treatment schedules for these crops, which will insure the grower adequate protection from insect losses and that his product be free from objectionable spray deposits. Two products of foreign origin, pyrethrum and rotenone, provided the basis for these safe insecticide schedules

but with the outbreak of the war the supply of these materials became greatly restricted. Thus it is necessary to develop substitutes and means of spreading the limited quantities of these materials available over as wide a range of crops and acreages as possible.

Aside from the insecticidal residue problem the canner, processor, and grower of peas, tomatoes, and beans has been confronted with the problem of food contamination by weevil grubs, tomato fruitworms, and tomato pinworms, which entered the seeds or fruits in the field and are not ordinarily eliminated during the processing operations. This problem is nationwide in scope insofar as tomatoes are concerned and in the instance of peas it is of paramount importance to the canner and grower of this crop in Washington, Oregon, and Utah. The results of the research control program on the pea weevil have led to the discovery of insecticides containing rotenone as a specific remedy for this pest and the development of insecticidal machinery which will quickly and effectively cover large areas. The effect of this discovery and its application has been to stabilize an industry in the Northwest that was on the verge of becoming demoralized. The results of the work on the tomato fruitworm in California, Utah, and Ohio have not been quite as satisfactory, although a partial remedy has been found in the use of cryolite and calcium arsenate. Cryolite has also been found to be a fairly satisfactory remedy for the tomato pinworm in California. It still remains a very definite need for a more toxic material to be used for control of the tomato fruitworm and the tomato pinworm.

Although the problem on Mexican bean beetle control had been effectively solved by the use of insecticides containing rotenone, the scarcity of this material caused by war conditions has led to a reopening of this problem on the basis of discovering or developing insecticides which will control this pest and not incur the harmful residue hazard. Excellent progress is being made in controlling the corn earworm as a pest of lima beans by the application of insecticides containing cryolite, particularly in Virginia and North Carolina, while this same insecticide is being used to good effect in controlling the lima bean pod borer on lima beans in southern California.

Vegetable plant lice, such as the pea aphid, turnip aphid, and aphids affecting potatoes, are pests of nation-wide importance. Measures which have been developed for controlling the pea aphid in Wisconsin have not been wholly successful. Timeliness of application of the remedy is a major factor in the effectiveness of the treatment, as well as the proper selection and proper application of the insecticide. In active cooperation with several of the affected States, a wealth of information on these important phases of pea aphid control is being accumulated, which, it is hoped, will contribute to an early and satisfactory solution of the problem. Methods which have been developed by this Bureau in Louisiana are now available for turnip aphid control. The solution of this problem should serve to place the production of turnip mustard greens in the South on a more substantial basis. The problem of aphids attacking potatoes and the control of the diseases which these pests transmit is still under investigation in Maine and considerable progress has been made during the past three seasons.

The wireworm problem, while primarily of the greatest importance to the growers of crops in the irrigated lands of the Northwest, affects growers in other areas of the United States, particularly in the early-season vegetable-producing areas of the Southeast. Extensive research on the control of wireworms by the use of chemicals has shown that a few materials are effective. The cost of such chemicals, however, is prohibitive on lands devoted to crops yielding a low return per acre. A study of soil moisture requirements and the effect of certain crops on wireworm populations has led to the recommendation of practical cultural procedures which will reduce wireworm losses. Such procedures involve the manipulation of irrigation water and the use of crop rotations which are agronomically feasible and lead to avoidance of serious losses from wireworms.

Investigations on the pepper weevil in California have demonstrated that this insect can be controlled by the proper application of a dust mixture containing cryolite or undiluted calcium arsenate and that by the use of specially constructed washing machines the residues left by these insecticides could be removed satisfactorily. The use of calcium arsenate, however, is likely to be followed by heavy infestations of aphids. It was found that these aphid infestations could be combated satisfactorily by including rotenone or nicotine in the dust mixtures applied primarily for the control of the pepper weevil. Owing to the scarcity of rotenone it will be necessary to attempt to develop a substitute for this purpose. The Sitona weevil, a new pest of peas, vetch, clover, and alfalfa, was first reported in North America during 1937 in the State of Washington. During 1942 preliminary experiments with various insecticides directed against the adults of the Sitona weevil indicated that compounds containing cryolite or arsenicals might be effective. Further investigations on the control of this pest are essential.

Mole crickets are especially injurious to seedling celery, cucurbit, strawberry and tomato plants, as well as to other crops, especially in the South. The results of investigations on mole crickets in Florida, which have been designed more recently to aid in the large-scale control program for these pests have demonstrated that the southern mole cricket was much less susceptible to baits containing calcium arsenate than was the Puerto Rican mole cricket and that sodium fluosilicate appears to be a much more satisfactory poison in the bait for the control of both species. It was also found that wheat bran is satisfactory as a carrier of the poison. These discoveries led to a great increase in efficiency in combating these pests and a reduction in the cost of control. Investigations also disclosed that clean culture of infested fields during the summer period led to the starvation of newly hatched mole crickets but that this procedure was contrary to recommended agronomic practices. This complication necessitates additional observations and experiments in an attempt to devise cultural control measures that can be used in lieu of applications of poisoned bait.

Investigations of the beet leafhopper in the Intermountain Region of Idaho, Utah, and Arizona, New Mexico, Oregon, Washington, Montana, and Wyoming have demonstrated that this insect requires a sequence of weed or cultivated host plants throughout the year in order to survive and to attain destructive abundance, and that enormous numbers of these pests breed in the extensive areas of weed host plants such as Russian-thistle and wild mustards which are

scattered over a wide expanse of territory and from which the leafhoppers move or "migrate" to the same cultivated areas each year. Information has been obtained, in cooperation with the Bureau of Plant Industry, on the location of the principal breeding grounds of the beet leafhopper in the territory mentioned, as well as their extent. It is believed that this information will aid greatly in the formulation of control measures, particularly the possibility of obtaining a permanent control of the beet leafhopper by measures which would eliminate or reduce the principal breeding areas of the insect to a status of unimportance by means of a program of effective land-improvement planning and range management, in cooperation with other interest agencies such as the Soil Conservation Service, Forest Service, and Grazing Service. It has been shown that early planting of sugar beets and beans, supplemented by other approved agronomic practices which result in advancing the growth of the crop before the spring migration of leafhoppers is helpful in reducing the degree of damage caused by curly top disease in the early and susceptible stage of growth of the small plants. Studies in Idaho and Oregon with various insecticides have indicated that some measure of relief may be obtained in controlling the beet leafhopper and the curly top disease which it transmits by the application of insecticides directed against the adults and nymphs, particularly at the time when large populations of leafhoppers are entering the sugar beet fields. Investigations in Utah have demonstrated the value of cheesecloth covers in protecting tomatoes against the beet leafhopper during the time of spring migration. In this same territory the value of multiple-hill plantings of tomatoes to compensate for loss in yield when the stand is reduced by curly top has also been shown.

In the course of the beet leafhopper investigations in California it has been found by means of the recovery of marked adults that the migrating beet leafhoppers cover a distance of at least 10 miles from the point of liberation. This constitutes the first direct evidence ever obtained regarding long-distance movements of the beet leafhopper in California. By following this technique it will be possible to more accurately record the local and long-distance movements of these pests from wild land breeding areas to cultivated crops and return, thus indicating definitely the areas of wild host plants which should be destroyed as a control measure. A good start has been made in evaluating the practice of spraying shrubs and similar vegetation in the foothills west of the San Joaquin Valley in California, where the beet leafhoppers congregate in the fall, as a measure of reducing the beet leafhopper population in this region which will have a profound effect on the control of this insect on cultivated crops.

Investigations in Arizona, New Mexico, California, and Oregon, on insects affecting sugar beets grown for seed have yielded information valuable to the beet seed industry. A very satisfactory control measure consisting of a spray of pyrethrum-in-oil has been developed for the control of the beet leafhopper when it is numerous on the seedling beets in the fall. A fairly satisfactory dust mixture consisting of pyrethrum, sulfur, and a diluent, has been developed for combating Lygus plant bugs on the beet seed stalks in the spring. No satisfactory remedy has been developed, however, to combat the larger stink bugs which also damage the seed stalks. The control of these insects attacking the seed of sugar beets is particularly important as a war-time measure since production of sugar beets is now dependent on domestic seed production.

Tobacco insect investigations: The primary emphasis on this project has been devoted to investigations having for their objective the investigation of insects which attack tobacco in the field and in storage.

Partial success has been attained during recent years in controlling flea beetles attacking tobacco in the plant bed and in subsequent stages of growth in the field by the use of dust mixtures containing rotenone. Owing to war conditions which have caused a scarcity of this material, it will be necessary to develop or to discover a satisfactory substitute.

The principal problem in controlling hornworms, one of the most serious pests affecting tobacco in the field, is the need to evolve a satisfactory substitute for lead arsenate. Cryolite has shown some promise as such a substitute. Encouraging success was attained during 1942 in using a trap containing an attractive poisoned bait, in which hornworm moths were captured. Similar success was obtained by the use of special devices known as "poison feeders," containing an attractive substance and a poison, which were placed on the borders of tobacco fields and which attracted and poisoned the hornworm moths. Further effort in improving the effectiveness of these devices is now in progress.

Suitable control measures have been developed for cutworms, grasshoppers, the tobacco budworm, the vegetable weevil, and slugs, all of which often damage growing tobacco. Satisfactory progress has been made also in devising remedies for thrips, sod webworms, the larvae of the green June beetle, and wireworms which attack tobacco in the plant bed or in the field. The current program includes research designed to improve the efficiency of these methods.

The continued losses from the ravages of the cigarette beetle and the tobacco moth in tobacco stored in the open type of storage structures has compelled further research to devise more effective methods for application under these conditions. The necessity of such research is emphasized by the fact that the Commodity Credit Corporation has made loans aggregating millions of dollars for the purchase of tobacco which, on account of world trade conditions, will need to be stored for an indefinite period, and protected from insect depredations.

Investigations of insects affecting greenhouse crops and bulbs: The emphasis on this project is being devoted to the development of insecticides to function as substitutes for standard insecticides which have been rendered scarce or unavailable due to war conditions or the ingredients of which are now being used in the preparation of war materials.

The work was reorganized during 1942 to meet the insecticide problems arising from war conditions. Changes in emphasis have been made in the interest of developing direct control measures for insects and related pests which occur not only upon greenhouse-grown vegetables and other plants but which also occur commonly on many food crops grown in large areas out of doors. This applies particularly to such insects and related pests as thrips, leafhoppers, aphids, mealybugs, red spiders and mites. The reorganization of this project has included the initiation of an extensive exploration of insecticide remedies for the general type of pests mentioned previously, including substitute materials for such insecticides as rotenone, pyrethrum, and tartar emetic.

Experiments during the last several years on the control of red spiders, thrips, whiteflies, aphids, mealybugs and scale insects which infest tomato lettuce, and cucumber, and which also injure floral crops grown in the greenhouse, have disclosed that these widely distributed pests can be controlled by the use of various spray combinations, or dust mixtures, or fumigants. Tests are being continued on various crops to determine the value of the various insecticidal treatments and the tolerance of the plants to such treatments, together with the beforementioned attempt to discover or develop insecticides which have been made scarce or unavailable by war conditions.

(1) CEREAL AND FORAGE INSECTS

Appropriation Act, 1943.....	\$374,395
Proposed transfer in 1944 estimates to	
"Salaries and Expenses, Office of the	
Administrator, Agricultural Research	
Administration".....	<u>-3,000</u>
Total available, 1943.....	\$371,395
Budget estimate, 1944.....	<u>380,170</u>
Increase (including decrease of \$2,800	
travel funds returned to surplus).....	<u>+8,775</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Cereal and forage insect investations.....	\$351,239	\$343,185	\$324,760	+\$11,57
2. Sugarcane insect investi- gations.....	28,715	25,410	25,410	--
Covered into Treasury in accordance with Public Law 674.....	--	2,800	--	-2,800
Unobligated balance	2,906	--	--	
Total estimate 1944 and comparable amounts 1943 and 1942	382,860	371,395	380,170	+8,775

INCREASE

The increase of \$8,775 in this item for 1944 consists of \$2,800 decrease in travel funds (returned to surplus in 1943) and:

(1) An increase of \$11,575 for the project "Cereal and Forage Insect Investigations," including:

(a) A decrease of \$4,000, which contemplates a curtailment in chinch bug investigations at Lafayette, Indiana, and Lawton, Oklahoma.

(b) A decrease of \$11,200, which contemplates a curtailment in white grub investigations at Madison, Wisconsin and Lafayette, Indiana.

(c) A decrease of \$3,225, which involves discontinuance of investigations conducted at Crowley, Louisiana on "Insects Attacking Rice in the Field."

(d) An increase of \$30,000 for "Investigations of European Corn Borer," which is explained as follows:

Objective: To expand research on the European corn borer in order to cope with its westward spread into the corn belt and increased intensity of infestation in portions of Indiana, Illinois, and Wisconsin; previously known to be infested.

The Problem and its Significance: Extensive surveys and field observations in 1941 and 1942 show that during the past two seasons, there has been a phenomenal spread of the borer to the westward in the corn belt states of Indiana, Illinois, Iowa, Missouri, and Wisconsin, as well as a striking increase in intensity of infestation in large portions of Indiana, Illinois, and Wisconsin previously known to be infested. For example, in 62 counties in Indiana, the number of borers per 100 corn plants increased from 77 in 1940 to 190 in 1942. In 6 Illinois counties, the increase was from 0 in 1940 to 111 in 1942 and in 6 counties in Wisconsin from 13 in 1940 to 33 in 1942. There have been significant increases in borer abundance in 6 of the 15 infested states east of Indiana and during 1942 infestation was found for the first time in eastern Iowa and northeastern Missouri, and in a total of 95 counties as follows: Illinois, 50; Indiana, 10; Iowa, 19; Missouri, 8; North Carolina, 1; Virginia, 3; and Wisconsin, 4.

The European corn borer is a serious pest of economic importance and in view of the emphasis being placed on staple crops in the war program of the country, it is considered urgent that efforts to solve the problem of borer control throughout the infested area be expanded .

Plan and Progress of Work: It is proposed to use the increase requested as follows:

(1) Approximately \$15,000 to establish a field station in southeastern Iowa or western Illinois in order to study the abundance, biology, habits,

food plants, and control of the corn borer under the conditions prevailing in that recently infested and most important corn-growing area. With the spread and increase of the borer farther westward in the heart of the main Corn Belt the insect has tended strongly toward the production of two generations per year rather than only one. Due to this tendency and to the differences in environmental conditions and farming practices as compared with those in the more eastern infested areas where previous studies have been conducted, it is essential that investigations should be made of the habits and reactions of the insect in relation to its importance and control in this new environment. It is anticipated that this work will be carried on in cooperation with the State Experiment Stations of Illinois, Iowa, and Missouri.

(2) Approximately \$7,000 for investigations of insecticides. Studies and commercial field trials have shown that the use of certain insecticides is highly effective and profitable in the control of the corn borer in high-value market sweet corn. Further work is needed to find cheaper and better insecticides and to develop apparatus and methods for their practical application in canning and lower value market sweet corn. Borer infestations in canning corn add considerably to the cost of producing and canning the crop, and material infestations in green corn completely ruin or greatly reduce its marketability. The only apparent way of meeting this situation is the improvement and reduction in cost of insecticidal methods of control to the point where they can be used profitably on these crops. It is proposed to carry on this work at the Bureau's field laboratory at Toledo, Ohio.

(3) Approximately \$8,000 for the colonization of parasites. Certain parasites which have been introduced and well established in the United States are of material aid in reducing borer populations in some of the older infested areas. The collection and colonization of these parasites in new areas are going forward under the current program, but with the rapid spread and increased abundance of the borer, this program of colonization should be enlarged. This involves the collection of larvae and pupae, rearing the parasites, eliminating the secondary parasites, and colonizing the primary ones in new localities. This work which is primarily of a seasonal nature, will be conducted mainly from the laboratory at Moorestown, New Jersey.

The total increase of \$30,000 will be applied by objects as follows:

Personnel

Field:

3 P-3 Associate Entomologists	\$9,600
2 P-2 Assistant Entomologists	5,200
1 P-1 Junior Entomologist	2,000
1 CAF-2 Junior Clerk-Stenographer	1,440
Temporary labor	<u>2,600</u>
Total personnel	<u>20,840</u>

Other Expenses

Travel	\$4,700
Rent	1,000
Supplies and Materials	1,460
Equipment	<u>2,000</u>
Total Other Expenses	<u>9,160</u>
Total Increase	<u>30,000</u>

WORK UNDER THIS APPROPRIATION

Objective: To discover and improve methods for the control of insect pests of corn, sorghums, sugarcane, small grains, soybeans and forage crops including grasses, clovers and alfalfa, during their growth in the field and during their storage and processing after harvest, and to make known control and preventive measures less expensive and more effective under existing conditions so as to insure adequate supplies of food and feed to meet war needs.

The Problem and its Significance: These crops are attacked by many different insects. Although they are the most essential and valuable crops grown, their acre value is low. Cost of control measures for the pests attacking them must therefore also be low. Estimates of the average annual losses caused by some of the more important of these insects are given below. With the special need due to war, and world conditions, of adequate supplies of these staple food and feed crops, the importance of finding and improving means of preventing these losses is unusually urgent. Satisfactory control measures have not yet been found or fully developed for many of the more injurious species and the need of modifying or substituting other control measures has been made urgent by soil conservation practices, emergency storage of food reserves, and scarcity of insecticides and fumigants due to their preemption for war activities.

<u>Insect</u>	<u>Crop</u>	<u>Average annual loss</u>
Barworm	Corn	\$79,000,000
Hessian fly	Wheat	13,000,000
Chinch bug	Corn, sorghum & small grains	15,000,000
Grasshoppers	Cereal and forage	25,700,000
Grain and flour weevils and moths	Stored grains and cereal products	366,000,000
Alfalfa weevil	Alfalfa	891,000
Alfalfa caterpillar	"	750,000
European corn borer	Corn	4,250,000
		(Including only the surveyed portion of the infested area.)
Sugarcane borer	Sugarcane (Also a serious pest of corn)	
	Rice	500,000
Rice stink bug	"	700,000

General Plan: In cooperation with other Departmental agencies, State Experiment stations, farmers, warehousemen and millers, to continue investigations now in progress at 26 field stations in strategic locations throughout the continental United States, to determine the habits, status as vectors of plant diseases, distribution and abundance of, and losses caused by, the insect pests of the above mentioned crops, and with this information as a basis to devise practicable measures of control through the adjustment of cultural and storage practices, development of resistant crop varieties or cheap, easily applied insecticides and fumigants, and, particularly in the case of accidentally introduced foreign pests, the introduction and dispersion of their natural enemies. The work is divided into two financial projects, as follows: (1) cereal and forage insect investigations, and (2) sugarcane and rice insects.

Example of Progress and Current Program: Most of these investigations, such as the breeding of resistant crop varieties, ecological studies to discover cultural methods of control, including beneficial crop rotation and practical field trials of these methods, require rather long terms of years of connected observations for the attainment of decisive results. However, while progress is necessarily gradual, definite results are achieved each year. The more important of the current results are outlined in the following sections.

Cereal and forage insect investigations:

Hessian fly: Moderate to heavy fly infestation occurred in the 1942 crop in much of the winter-wheat belt. Additional data have been obtained on safe sowing dates to avoid fall infestation. In the development of resistant varieties at least 50 out of about 3,000 tested have shown high resistance to Hessian fly attack. Several of these have been crossed with other varieties possessing high resistance to one or more fungous diseases and a number of desirable hybrids possessing both fly and disease resistance are well advanced.

Chinch bug: Owing to probable scarcity of creosote for use on chinch bug barriers 15 promising chemicals were tested as substitutes. Several of these were found worthy of consideration, including dinitro-ortho-cresol dust and certain tar oils and similar by-products of the coking and oil industries. Further progress was made in the development of resistant varieties of sorghum and corn and in the search for resistant barleys.

Corn Earworm: The use of the newly originated oil-pyrethrum method of control for earworm in market sweet corn is increasing and proving very profitable. Highly favorable results were obtained in its experimental use on sweet corn grown for seed. Promising earworm-resistant strains of field and sweet corn have been found and proven homozygous for resistance. Cooperative tests of promising resistant lines have been continued at a number of Central and Eastern State Experiment Stations.

Insects Attacking Alfalfa: Cultural methods of control worked out for Lygus spp. and other sucking bugs that greatly reduce the yield of alfalfa seed have been quite successful when applied on a community basis in Southern Arizona. These appear to be less practicable in other important alfalfa seed producing States, however, and further efforts are being made to find usable and effective measures for use in these States. Recent observations also indicate that these sucking bugs reduce the yield of alfalfa hay as well as seed crops.

Posts of Annual Legumes: Losses of vetch seed caused by the vetch bruchid, recently discovered in western Oregon and Washington, the main seed producing region of the country, have rapidly increased. Studies indicate that it may be possible to combat it successfully by the use of rotenone dust.

Several other species have caused serious concern during the past year as pests of annual legumes in this seed producing area, including the garden slug, the newly discovered European pea weevil, and the western spotted cucumber beetle. Studies to determine their habits, the areas affected, and best methods of control are in progress.

In the Eastern States, following the discovery last year that thrips are one of the causes of peanut "pouts" experiments on their control by means of insecticides have been conducted but conclusive results have not yet been obtained. Field experiments on the insecticidal control of leafhoppers injuring alfalfa and peanuts have shown favorable results.

Studies have also been initiated on the biology and control of the sweet clover weevil, another European pest that has recently become injuriously abundant in the North Central States.

Grasshoppers and Mormon Crickets: The current scarcity, due to war conditions, of arsenicals for use as insecticides necessitated an effort to utilize other available poisons for use in grasshopper bait. Field tests have shown sodium fluosilicate, now available in large quantities, to be satisfactory, and much of it was used during the past season. Further research continues to indicate the eventual feasibility of simplifying and lowering the cost of baits for grasshoppers and Mormon crickets by greatly

reducing the water content or substituting cheap mineral oil, thus making the mixed baits more suitable for easy mixing, airplane and mechanical application, transportation, and storage. Studies on methods of making surveys essential to effective grasshopper control campaigns are reducing the cost of this operation. Ecological studies of the Mormon cricket indicate the possibility of finding the restricted areas of perennial infestation and, by poisoning the crickets in these areas, preventing widespread outbreaks such as those of recent years.

White Grubs: Tests made in Wisconsin, where these grubs extensively damage pastures and field crops, show sweet clover to be much less susceptible to attack than grasses and grains. This fact is being utilized in beneficial cropping practices. Experiments to determine the effectiveness against white grubs of a nematode parasite of the Japanese beetle gave negative results but led to the discovery of other nematodes infesting the grubs in the field that may be parasitic and susceptible to artificial increase.

Insects Attacking Stored Grains and Grain Products: Due to preemption for war industries of chemicals commonly used as grain fumigants a number of new compounds have been tested for this purpose, three of which are quite promising. A cheap and apparently effective system of regular inspection and fumigation of wheat in Ever-normal Granary storage for prevention of insect damage has been developed. Laboratory and field studies indicate that low moisture content and temperatures below 65° F. inhibit the development of damaging infestations in grain and flour, and that practical ways of utilizing this information may be found. Tests show that viability of hybrid seed corn was greatly reduced by continuous exposure to paradichloro benzene, but not by naphthalene, commonly used in stored seed grains to prevent insect injury. Repeated exposure of stored wheat to a fumigant containing methyl bromide also greatly reduced germination.

Tests of methyl bromide for fumigation of bagged grain, seed and milled cereal products under gas-tight tarpaulins were highly successful.

Observations on a centrifugal machine for mechanically killing insects in grain, flour and similar products indicated it to be highly efficient and economical.

White-fringed Beetle: Crop rotations that promise to give practical control of this insect under farm conditions have been developed from cultural control experiments. Laboratory tests of parasitic nematodes produced from 32 to 100 percent mortality of larvae but their effectiveness in the field and the possibility of using them in control operations have not yet been demonstrated. For poisoning the adults, a semi-concentrated spray has been developed that persists on the plants for long periods in spite of the frequent rains occurring in the infested area.

European corn borer: Losses of corn caused by this insect and the area known to be infested showed a striking increase in 1941 and 1942, particularly in the Lake States comprising the eastern portion of the main Corn Belt. Efforts to find satisfactory control measures have therefore been continued.

and increased with special emphasis on the most likely source of relief, the finding and improvement of borer-resistant lines of field and sweet corn. In tests of several hundred inbred and hybrid lines during 1941 several of the inbreds showed a considerable degree of resistance and the ability to transmit this quality to hybrid progeny.

Experimental large-scale trials of sprays and dusts on high-value green corn for the market showed them to be highly profitable and better power equipment for their application is being developed.

A total of 66,000 specimens of corn borer parasites were reared and colonized in infested territory in order to increase their dispersion and abundance along with the host.

A general Farmers' Bulletin on the habits and control of the borer and a circular describing the use of insecticides on market sweet corn have been published during the year.

Sugarcane and Rice Insects:

Sugarcane Borer: From a fall survey of the 1941 crop in Louisiana it was estimated that approximately 20 percent of the joints and 70 percent of the stalks were bored by this insect. This is the highest infestation since 1934. Large-scale field experiments with the application of cryolite dust have continued to show promise of being practical and profitable. Semi-commercial trials of this method, including airplane applications were made on about 800 acres in 1942.

Of 1,039 seedling varieties examined for resistance to the borer in 1941, 31 had less than 10 percent of their joints bored as compared with 30 percent in the susceptible check. Four varieties found resistant in these tests are being used as resistant parents by Department cane breeders in further crossings and selections. At least one of these has transmitted resistance to its progeny. Several commercial and promising experimental varieties have shown much less than average infestations.

Five large-acreage tests of removing "dead hearts" caused by first-generation borers, at a cost of about \$1.00 per acre, appeared to be profitable operations, only 52 percent of the stalks being found bored in August as compared with 70 percent in the untreated check areas.

Rearing and colonization of two dipterous parasites was continued. September examinations in the Florida colonization area showed a total of 55 percent parasitization of the borer.

West Indian Sugarcane Mite: An effort to eradicate a local infestation in Florida has apparently been successful.

Rice Stink Bug: Studies have shown this insect to be one of the major causes of "peckiness" in rice and of losses in yield, due to its feeding on the developing kernels. Experiments on its control by means of insecticides gave negative results, but some variation has been found in degree of injury it does to different varieties.

Insect Pests of Stored Rice: A successful experimental apparatus was devised for killing the insects in rice mill tailings economically by means of infra-red radiation and thus preventing their spread back into the mill. Practical methods of controlling insects attacking rice in mills and warehouses have been worked out and published in a Farmers' Bulletin, and the work has been discontinued.

EUROPEAN CORN BORER CONTROL

The budget schedule reflects the obligations incurred under this subappropriation in 1942. The item was discontinued in the 1943 Act, and is not estimated for in 1944.

(n) BARBERRY ERADICATION

Appropriation Act, 1943.....	\$185,970
Proposed transfer in 1944 estimates to	
"Salaries and Expenses, Office of the	
Administrator, Agricultural Research	
Administration".....	-3,000
Total available, 1943.....	182,970
Budget estimate, 1944.....	173,250
Decrease (including decrease of \$600 travel	
funds returned to surplus).....	-9,720

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Barberrry Eradication:				
(a) Eradication of the				
barberrry in the 13				
States where work was				
begun in 1918.....	\$155,361	\$155,470	\$146,350	-9,120 (1)
(b) Eradication of the				
barberrry in other States	20,845	22,700	22,700	--
(c) Inspection of nurs-				
eries which ship bar-				
berries interstate.....	4,525	4,200	4,200	--
Covered into Treasury in				
accordance with Public				
Law 674.....	--	600	--	-600
Unobligated balance	1,904	--	--	--
Total estimate 1944 and:				
comparable amounts				
1943 and 1942	182,635	182,970	173,250	-9,720

DECREASE

The decrease of \$9,720 in this item for 1944 consists of \$600 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$9,120 in the project for "Eradication of the barberry in the 15 States where work was begun in 1918." This contemplates a decrease of personnel in these States, namely, Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming.

WORK UNDER THIS APPROPRIATION

Objective: To prevent widespread and costly damage to wheat, oats, barley and rye through the control of black stem rust in the principal grain-producing areas of the United States by eradicating the rust-spreading barberry bushes.

The Problem and its Significance: The control problem involves the location and eradication of the rust-spreading barberry, *Berberis vulgaris*, in 17 grain-growing States and of the native barberries, *Berberis fendleri* and *Berberis canadensis*, in the grain-producing areas of western Colorado and of Virginia and West Virginia respectively. The common barberry is an introduced shrub that has been planted throughout the United States since the early settlement of this country. It escaped from cultivation and became widely distributed in timbered areas, along stream banks, fence rows, and other uncultivated lands where it is a serious hazard to the production of small grains.

Stem rust is the most destructive of all diseases that attack wheat, oats, barley and rye. It is caused by a fungus that lives on the leaves of barberry bushes in the spring, and on grains and grasses during the remainder of the year. The winter spores germinate each spring and cause infection on barberry leaves. Spores produced on the barberry leaves infect nearby grains and grasses, producing the summer stage of the disease. In this stage the rust spreads from field to field, often resulting in severe damage to crops after the principal cost of production has been incurred. The summer stage of the rust does not survive the winter in the northern part of the United States. Thus, by removing barberries, grain crops are protected from rust epidemics of local origin.

The significance of barberries as a source of local epidemics of stem rust can be seen each year in grain-producing areas where these bushes are present. Under such conditions small grain crops frequently are repeated failures because of stem rust infection. The barberry eradication work has eliminated thousands of these local outbreaks of the disease. As a result, losses from this disease aggregating millions of dollars have been prevented and numerous areas where stem rust caused partial or total losses are now producing profitable crops.

Barberry bushes also are a source of new and potentially destructive races of the stem rust fungus. Frequently a new strain of rust appears in the vicinity of barberry bushes that is capable of attacking varieties of

grain that over a period of years have become recognized as resistant to the disease. These new strains develop only on barberry bushes, thus the eradication program serves a double purpose. It removes local sources of inoculum and reduces the source of new strains of rust that may attack new and improved varieties of grain. Approximately 180 different strains of stem rust fungus have been identified, but only a few of them are likely to appear during any one year.

General Plan: Barberry eradication is carried on by the Bureau of Entomology and Plant Quarantine in cooperation with 17 States. Close working relations are maintained with Federal, State and local agencies interested in the program, including those engaged in breeding new and improved rust-resisting grains. Surveys are conducted each year to determine where and to what extent stem rust is causing damage, as a basis for applying effective control measures. Timbered areas, stream banks, fence rows, and other uncultivated lands are systematically examined to locate barberries. The bushes are eradicated by treating them with salt or other chemicals, or by grubbing. The infested areas are mapped and at regular intervals they are reworked to prevent reinfestation from seeds that were widely distributed before the original bushes were destroyed, and to eliminate the new bushes before they become old enough to produce seed. The eradication program is supplemented by educational work to inform property owners about stem rust and its control and to obtain their active cooperation in locating and destroying barberry bushes.

PROGRESS AND CURRENT PROGRAM

Eradication of Barberry in the 17 Cooperating States: During the past year the barberry eradication program was continued along much the same general plan of operation that has made possible effective use of WPA labor in recent years. However, progress was greatly curtailed when Federal agency projects were discontinued on December 31, 1941, and war industries began to absorb much of the better qualified labor previously available for projects of this type. Adjustments in field procedures have been made as the labor supply diminished in an attempt to prevent reinfestation of extensive areas where the initial eradication of barberry bushes has been accomplished.

A summary of accomplishments for the year shows that Federal, State, and county agencies and individuals eradicated approximately 22 million barberry bushes on 4,000 properties in 196 counties. Of the total barberry bushes destroyed during the year, more than 20 million were of the two native species Berberis canadensis and B. fendleri. The former is found only in Virginia and West Virginia, and in limited areas in Illinois, Indiana, Iowa, and Missouri, while the latter occurs in southwest Colorado. Areas cleared of bushes totaled 29,347 square miles. The results, by States, are shown in the attached table.

During the growing season of 1942, crop and weather conditions were ideal for the development of stem rust, yet losses from this disease were smaller than in any year since the early 1930's. Leaf rusts of wheat, oats, and flax were unusually severe showing that climatic conditions were favorable for stem rust development. With but few exceptions, the only damaging

stem rust found this year was that which spread from rusted barberry bushes to nearby grain fields. It is reasonable to assume that, if the 300,000,000 barberry bushes that have been eradicated since 1918 were still in the control area, grain losses from stem rust would have been exceedingly heavy this year.

The present status of the program in the 17 States comprising the control areas may be briefly described as follows. At the close of the fiscal year the initial survey had been completed in more than 850 of about 1,050 counties needing attention. When the expanded program, made possible with WPA funds in 1934, was undertaken, about 21 percent of the total area was considered relatively free of barberry bushes as compared with 65 percent at the close of the fiscal year 1942. Seedling bushes are developing in areas comprising about 22,000 square miles in 240 important grain-growing counties where initial control work was completed prior to 1938. These bushes should be destroyed to prevent them from reaching the seed-producing age.

The amount of labor available for this program from WPA and other sources is diminishing. This has an important direct effect on the program, as it retards the effort to prevent the regrowth of barberry bushes in known areas of infestation. During the next year, available personnel will be used largely in making surveys and removing barberry bushes in known areas of infestation in or immediately adjacent to the more important grain-growing areas, thus providing the maximum protection possible to areas where the greatest amount of wheat is grown.

Inspection of Nurseries that Ship Barberries Interstate: Eliminating rust-susceptible species of barberry from nurseries is an essential part of the stem rust control program. Each of the 17 States participating in this work has laws prohibiting the propagation or sale of other than approved varieties. A Federal quarantine prohibits shipment of susceptible species into or between States participating in the control program. In order to properly administer the quarantine, susceptibility tests are conducted to determine the identity and rust reaction of any new species or variety of barberry that appears on the market.

In 1942, permits were granted to 61 nurseries to ship immune species of barberry into States protected by the Federal quarantine. Permits were refused 10 nurseries, and 1 other making application for inspection did not require permits. Nurserymen outside the control area are cooperating by destroying their rust-susceptible plants and restricting their barberry stock to approved immune or highly-resistant species. This year 13 nurserymen cooperated in this work and destroyed 6,316 susceptible barberries that were growing in their nurseries. The outlook for further cooperation of this sort by nurserymen outside the control area is excellent.

Accomplishments during Fiscal Year 1942

State	Square Miles Survived	Properties Cleared		Bushes Destroyed		Salt Used (Tons)
		New	Old	Vegetables	Native	
Colorado	429	27	133	60	3,400,310	.5
Illinois	2,371	96	105	1,095	-	2.7
Indiana	1,818	46	81	1,841	-	1.9
Iowa	2,948	259	243	12,786	-	25.5
Michigan	2,999	163	148	3,353	-	15.7
Minnesota	4,725	94	64	2,238	-	10.1
Montana	38	32	17	212	-	.6
Nebraska	1,535	5	19	78	-	.1
North Dakota	4,973	4	6	108	-	.3
Ohio	770	41	56	2,242	-	5.0
South Dakota	238	2	1	20	-	.1
Wisconsin	1,833	296	299	12,650	-	34.0
Wyoming	0	0	0	0	-	0
Subtotals	24,677	1,065	1,172	37,333	3,400,310	96.5
Missouri	2,830	36	9	366	-	.7
Pennsylvania	1,481	549	746	738,017	-	317.1
Virginia	235	277	31	2	8,048,661	480.6
West Virginia	124	33	89	4	9,732,408	370.3
Subtotals	4,670	895	875	738,389	17,781,089	1,168.7
Grand Totals	29,347	1,960	2,047	775,722	21,181,399	1,265.2

Of the total barberry bushes destroyed during the year, more than 20 million were of the two native species, *Berberis canadensis* and *B. fendleri*. The former is found only in Virginia and West Virginia, and in limited areas in Illinois, Indiana, Iowa, and Missouri, while the other is restricted to southwest Colorado.

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SUPPLEMENTAL FUNDS

Direct Allotments

Projects	:	Obligations
	:	1942
Emergency Relief Appropriation Acts: Barberrry	:	
Liquidation.....	:	\$379,375

(n) COTTON INSECTS

Appropriation Act, 1943.....	\$148,439
Budget estimate, 1944.....	<u>140,730</u>
Decrease (including decrease of \$300 travel funds returned to surplus).....	<u>-7,709</u>

PROJECT STATEMENT

Projects	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Cotton Insect Investiga- tions:				
(a) Boll weevil control investigations.....	\$47,200	\$49,000	\$41,591	\$ -7,409 (1)
(b) Boll weevil control on: Sea Island Cotton, In- vestigations of.....	6,300	6,500	6,500	- -
(c) Pink bollworm investi- gations.....	29,158	30,000	30,000	- -
(d) Bollworm control in- vestigations.....	10,000	10,000	10,000	- -
(e) Plant bugs affecting irrigated cotton, in- vestigations of.....	9,900	11,000	11,000	- -
(f) Cotton fleahopper and related insects, Investi- gations of.....	17,200	18,000	18,000	- -
(g) Cotton aphid investi- gations of.....	15,900	15,748	15,748	- -
(h) Investigations of various cotton insects	5,951	6,179	6,179	- -
(i) Importation of natural enemies of cotton insects.....	1,760	1,712	1,712	- -
Covered into Treasury in accordance with Public Law 674.....	- -	300	- -	- 300
Unobligated balance.....	2,590	- -	- -	- -
Total estimate or appropriation.....	145,959	148,439	140,730	-7,709

DECREASE

The decrease of \$7,709 in this item for 1944 consists of \$300 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$7,409 in the project "Boll Weevil Control Investigation. This will include a reduction in activities being carried on at Tifton, Georgia, Tallulah, Louisiana, and State College, Mississippi.

WORK UNDER THIS APPROPRIATION

Objective: To develop new methods and improve the present measures of control of insects attacking cotton in order to reduce the losses caused by cotton insects, which in turn will lower the cost of production and increase the farm income. During the war emergency there are several special objectives:

- (1) To increase the quantity and quality of long staple cotton urgently needed for war purposes;
- (2) To develop methods of conserving insecticides containing essential materials needed in the war effort, such as copper, arsenic, and rotenone;
- (3) To develop methods of control to reduce the use of dusting and spraying machines so that essential metals used in their manufacture can be used in war industries;
- (4) To keep the Office for Agricultural War Relations, War Production Board, Office of Price Administration and other war agencies, the cotton growers, insecticide manufacturers and others interested in cotton production accurately informed concerning cotton insect conditions, so that insecticides and machinery may be available in the areas where needed.

The Problem and its Significance: Cotton is grown on 25,000,000 acres in 15 states and is the most important crop in 11 states. Cotton and cotton products have become increasingly important because of the war. It takes about 75 pounds of cotton to equip and maintain a soldier for one year - two to three times that much if he is on combat duty. There is a serious shortage of the better grades of long staple cotton used for balloons, parachutes, rafts, tires and other essential war purposes. The importation of vegetable oils has been greatly curtailed and has greatly increased the demand for cottonseed oil. The annual production of approximately 12,000,000 bales of lint is used chiefly for clothing. 250 items used by the military personnel are made from cotton, more than a million bales of linters are used in the manufacture of cellulose for explosives and for other purposes, approximately 1,500,000 pounds of cottonseed oil are used in the manufacture of food, soap, glycerine, paints and other items, more than 2,000,000 tons of cottonseed meal are used to furnish the principal concentrated protein food for milk and beef production. Insect damage is the principal hazard to profitable cotton production and causes losses amounting to \$200,000,000 annually. Losses from the boll weevil were more serious in 1941 than in any recent year. In 1941 and again in 1942 serious losses occurred in some areas because insecticides and dusting machines were not available when needed. The shortage of

arsenical insecticides was due to their greatly increased use and the shortage of dusting machines was caused partly by curtailment of production due to war conditions.

General Plan: Field and laboratory experiments are conducted in cooperation with State Experiment Stations, other Federal agencies and farmers. Research laboratories are located in regions where serious cotton insect problems occur in South Carolina, Georgia, Mississippi, Louisiana, Texas, and Arizona. New insecticides are tested in the laboratory and in field cages against various cotton insects and the materials that show promising results are then tested under field conditions. Studies of the life histories and habits of insects are made as a basis for developing control and suppressive measures, and for preventing spread to new areas. Records are made of the seasonal abundance and damage of insects in different areas and timely information on control is furnished to the farmers. Many entomologists employed by state and Federal agencies are cooperating in keeping this Bureau informed in regard to cotton insect conditions. The information received from many sources enables the Bureau to keep the Office for Agricultural War Relations, War Production Board, Office of Price Administration, the cotton growers, and insecticide manufacturers informed concerning cotton insect conditions.

Examples of Progress and Current Program: The war has made necessary many changes in the program and has caused emphasis to be placed on the activities that are of the greatest help in the winning of the war. The Bureau now keeps informed in regard to cotton insect conditions in all of the states in order to furnish information promptly to the Office for Agricultural War Relations, War Production Board, Office of Price Administration, manufacturers of insecticides, dusting and spraying machinery, and other agencies. This service was of great value during 1942 as the war agencies and the manufacturers depended upon it in arranging the distribution of insecticides so that they could be shipped where and when they were most urgently needed to prevent disastrous losses from the boll weevil, bollworm, and cotton leafworm.

The reduced supplies of certain insecticides has made it necessary to give special attention to investigations of control by smaller dosages, by the use of substitute materials, and by cultural practices that do not necessitate the use of insecticides and machinery for applying them. During the fall of 1942 wide publicity was given to the early fall cutting or plowing under of the cotton stalks as a means of reducing losses from the boll weevil in 1943 with less use of insecticides. In this campaign the Bureau had the active cooperation of the National Cotton Council of America and many state and Federal agencies including the Extension Service and all other agencies in the Department that are concerned with cotton production.

The urgent need for war purposes of the better grades of long staple cotton has caused the Bureau to give special attention to the control of insects in the areas where long staple cotton is grown.

Attention has been given during recent years to the improvement of calcium arsenate. After this material was developed about 25 years ago by this Department as an insecticide for the control of the boll weevil, there was used annually between 20 to 40 million pounds for the control of the boll weevil, bollworm and cotton leaf worm, until 1941 and again in 1942, when approximately 70 million pounds of calcium arsenate was used for the control of cotton insects. Even a slight increase in the effectiveness of this material would be worth many thousands of dollars to the growers. Studies have shown that the water soluble arsenic and the size of particles influence the toxicity of calcium arsenate and that these factors can be controlled in the manufacturing process without increasing the cost. Calcium arsenate with high water soluble arsenic and large particles has been found more toxic to insects in cage tests but has not given larger gains in field tests than intermediate or low water soluble calcium arsenate, probably because of the increase in the number of aphids following its use. The adverse effects of calcium arsenate on the cotton plant and on the parasites and predators of the leaf aphids often enable these insects to increase to injurious numbers and this is the most objectionable factor to the use of calcium arsenate. Progress has been made in reducing the aphid problem following the use of calcium arsenate by the addition of rotenone, nicotine and zinc and iron salts to the calcium arsenate. Small quantities of derris or other dusts containing rotenone and nicotine added to calcium arsenate gave satisfactory control of the cotton aphid in field tests conducted during 1941 and 1942. However, these materials are not effective under certain conditions and more work is needed on the relationship of ecological factors to their effectiveness. Additional information is needed as to the effects of various kinds of calcium arsenate on the cotton plants and on the boll weevil, cotton aphid, and other insects.

The revival of the Sea Island cotton industry in the United States is dependent upon controlling the boll weevil. Sea Island cotton is a different species of plant than ordinary or upland cotton. Weevil control is especially difficult because Sea Island cotton besides being especially attractive to the boll weevil has a longer growing period, and has softer bolls that may be seriously injured by the weevils until the cotton is open. Weevil control on this cotton is more expensive than on upland cotton but experiments have shown that it is economically feasible to control the pest on Sea Island cotton by dusting with calcium arsenate.

Practically all of the American Egyptian cotton is produced in Arizona and other irrigated sections of the southwest. The better grades of this long staple cotton are especially needed for military uses and the Department has requested the growers to increase the 1942 production by 75,000 acres. Control of the plant bugs to increase the yields and prevent staining of the lint is necessary to produce the quantity and quality of this cotton needed for war purposes. There are several species of plant bugs that migrate to cotton from the desert vegetation and from other crops, such as alfalfa and sugar beets, but the abundance of the various species varies considerably from season to season, depending upon the climatic conditions and the acreages devoted to other crops. Recent investigations have shown that dusting with a mixture of paris green and sulfur is a fairly effective control for some species but is not so good for other species. Furthermore the paris green contains two strategic materials - copper and arsenic - and further work is needed in testing other insecticides as substitutes for paris green and to develop a more effective insecticide for other species.

of this group. Over a million pounds of the paris green-sulfur dust were used in Arizona last season.

The cotton flea hopper, the tranished plant bug, the rapid plant bug, and other related insects are often serious pests of cotton. Their destruction of the small squares and bolls early in the season not only causes serious losses but makes the crop later and thus more liable to injury from other insects. Sulfur and mistures of sulfur and calcium arsenate or paris green have been the standard control measures for these insects since they were developed some years ago. Basic copper arsenate, a new insecticide, has given good results in preliminary tests but is now restricted in production because of the war.

The bollworm occurs over the entire cotton belt and is at times the most injurious cotton insect in some areas. It is also one of the most difficult to control because of the short time that insecticides are effective between hatching and the entrance of larvae into the squares or bolls. Lead arsenate and calcium arsenate have for some years been recommended for the control of this insect, but recent experiments indicate that cryolite and basic copper arsenate may be even more effective.

The presence of the pink bollworm in the Lower Rio Grande Valley of Texas constitutes a serious menace to the cotton industry because of the danger os spread to other areas through the almost continuous plantings of cotton. It also presents additional problems in control because investigations have shown that the semi-tropical climate permits the growth of cotton and the development of larvae throughout the year in addition to the formation of resting stage larvae. The latter enables the species to survive when no food is available in colder areas. Special attention is given to developing improvements in the field cleanup and other repressive measures used in the control program through the determination of where and in what stage of development the pink bollworms are present in each month of the year and the importance of other wild host plants. Emphasis has also been given to determining the most effective dates for fall cleanup and spring plantings and to methods of reducing the labor required in determining the field population through studies of the correlation between green boll examinations and gin trash examinations. The results have indicated a general dispersal of moths late in the season after the earlier fields are harvested and have emphasized the need of uniformity in dates of planting and cleanup.

(6) PINK BOLLWORM AND THURBERIA WEEVIL CONTROL

Appropriation Act, 1943	\$483,135
Budget estimate, 1944	<u>457,460</u>
Decrease (including decrease of \$1,600 travel funds returned to surplus)	<u>-25,675</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase decrease
1. Pink bollworm and thurberia weevil control:				
(a) Inspection to determine status and possible presence of the pink bollworm and thurberia weevil within and without regulated areas ...	\$146,900	\$110,000	\$110,000	--
(b) Regulatory operations to suppress and prevent the spread of the pink bollworm and thurberia weevil as required by Federal quarantines on these insects	193,471	166,535	166,535	--
(c) Control operations for suppression or eradication of infestations of the pink bollworm	106,177	94,000	69,925	-\$24,07
(d) Eradication of wild cotton in Florida for protection of cultivated cotton from pink bollworm	63,513	84,000	84,000	--
(e) Cooperation with the Mexican Government to control pink bollworm infestations to prevent spread into the United States	--	27,000	27,000	--
Covered into Treasury in accordance with Public Law 674	--	1,600	--	-1,60
Unobligated balance	20,554	--	--	--
Total estimate or appropriation	530,615	483,135	457,460	-25,6

DECREASE

The decrease of \$25,675 in this item for 1944 consists of \$1,600 decrease travel funds (returned to surplus in 1943) and:

(1) A decrease of \$24,075 in the project "Control operations for suppression or eradication of infestations of the pink bollworm," which contemplates a reduction in the amount of temporary labor engaged in the cleanup of cotton stalks in the Lower Rio Grande Valley.

WORK UNDER THIS APPROPRIATION

Objective: To prevent the spread of pink bollworm and *Thurberia* weevil from infested areas within the United States; to eradicate infestation of the pink bollworm from sections remote from the infested area; and to cooperate with the Mexican Government or local Mexican authorities in survey and control operations on the pink bollworm; thus protecting cotton production within the United States from these important pests which are established only in limited areas along the Mexican border.

The Problem and its Significance: The pink bollworm of cotton continues to be recognized by entomologists and growers of all cotton producing countries as the most destructive of all cotton insect pests. The menace to the cotton crop of this country has not been lessened in any particular during the cotton season just ended because a much heavier than usual infestation developed in the Lower Rio Grande Valley of Texas, and from this, infestation spread to counties to the north of that Valley which had either not been infested during the past two years, or in some instances had never before been known to be infested with the pink bollworm. Should the pink bollworm become established in these additional counties in south Texas the danger of the spread of the insect to the main cotton belt would be greatly increased. The southern half of the cotton belt which comprises more than half of the cotton acreage in the United States is comparable to areas in other countries where the pest has inflicted considerable losses. Reports from several of the principal cotton growing regions of the world indicate an annual average loss of more than 20% because of pink bollworm infestation. Its habit of feeding inside the immature cotton boll results in stained and cut fibers and a reduction of the oil content of the seed.

The *Thurberia* weevil is very similar in structure and in feeding habits to the common boll weevil of the South, and it has adapted itself to the arid mountain areas of Mexico and Arizona. Its native host is *Thurberia* cotton which grows wild in the mountain areas of that region, but it feeds and breeds freely on cultivated cotton and develops best under climatic conditions unfavorable to the true boll weevil.

The establishment of these pests in the main cotton producing sections of our country would cause excessive losses, and would add to the losses already being caused by established insects, further increasing the cost of producing cotton and lowering the quality of lint, and reducing the production of seed valuable for oil, meal, and other products.

General Plan: The work consists of enforcement of the Federal quarantines to prevent spread by artificial means; cooperation with the states to assure compliance with required control measures within the infested areas;

conducting control operations to prevent the build-up of infestation that would cause increased damage and which would thereby increase the probability of spread to noninfested areas; eradication of infestation where practicable; and the inspection of the cotton to determine the status of infestation in areas that are now known to be infested, and to determine the presence or absence of the insects in localities in which they are not known to exist. These activities are all conducted in cooperation with state agencies, other federal agencies, farmers, agricultural associations, and organizations representing cotton growers, processors, factors and exporters, and other local agencies. An important phase is the control work carried on cooperatively with the Agricultural Department of the Republic of Mexico, which contributes the services of some 30 employees, together with equipment and incidental expenses. A similar type of cooperation is received from the various cotton-producing States, while processors, ginner and farmers make substantial contributions to the work by incurring the extra expense involved in sanitation of premises, segregation of products at ginning plants, destruction of cotton stalks, delayed planting and other practices, which would not be necessary in the normal course of their operations but which are willingly undertaken as a part of the effort directed against the pink bollworm.

Full time employees are located in Arizona, Florida, New Mexico and Texas, with field headquarters in San Antonio, Texas. District and sub-district stations are maintained within the regulated areas at places conveniently accessible to the growers and cotton processors and shippers. The administration of the program is on a work project basis, each work project embracing a main objective of the program.

Examples of Progress and Current Program:

Inspection to determine status and possible presence of the pink bollworm and Thurberia weevil within and without regulated areas: This portion of the current pink bollworm program continues to be of greatest interest to cotton growers of the main cotton belt. Careful attention is, therefore, given to inspection for the pink bollworm, first, in the regulated areas now known to be infested with the pink bollworm to determine the changes occurring in the intensity of infestations and whether any part or all of these areas can be released with safety from quarantine, and second, inspections made in areas thought to be free from the pest to determine as early as possible whether the pink bollworm has been carried to new localities, and to eradicate such incipient infestations, if any are discovered.

Principal dependence in the inspection for the pink bollworm is placed upon the use of a large number of units of gin trash inspection machines, which make it possible to give much more effective and thorough inspection of the cotton belt as a whole than was the case when it was possible only to conduct field inspection of cotton bolls during the growing season. However, the field inspection of cotton bolls continues to be an important supplementary method of inspection. During the 1942 season there was a dispersal of the pink bollworm in southern Texas so late in the season as to prevent its detection through examination of gin trash; consequently, field inspection of bolls was undertaken, and such inspections

have revealed infestations that were not discovered during the season when the cotton crop was being harvested. This unusual condition indicates the importance of continuing to make effective use of a combination of methods of inspection for the pink bollworm.

Regulatory operations to suppress and prevent spread of the pink bollworm and Thurberia weevil as required by Federal quarantines on these insects: In the regulated areas the growers and processors realize that the quarantine measures enforced by the Department in cooperation with state agencies are responsible in a considerable measure for holding in check the infestation. As a matter of fact the measures required under the quarantine for local treatment of products before permitting them to enter into the channels of trade are proving adequate in some sections, where climatic conditions are not favorable for the insect, to prevent the pink bollworm from becoming established, even though reinfestation from heavily infested areas along the Mexican border has been recurring periodically. Responsible cotton growers, processors, and others interested in the cotton industry located in the free areas feel that the regulatory measures conducted inside the quarantined areas have prevented the spread of the pink bollworm by artificial means to their communities. Growers in free areas immediately adjacent to pink bollworm infested areas are particularly insistent upon rigid enforcement of the quarantine regulations.

Control operations for suppression or eradication of infestations of the pink bollworm: It is impossible to determine the effectiveness of the control program in the Big Bend area of Texas as practiced in the fall of 1941 and the spring of 1942 because the area was visited by a very destructive flood before the crop was matured in the early fall of 1942. The method followed in the Big Bend of Texas in controlling the pink bollworm is to delay planting in the spring and to clean up the fields in the fall immediately following harvest of the crop. This results in a shortening of the growing period, giving the pink bollworm less time in which to build up infestation. During 1942 one or two growers of the Big Bend area of Texas endeavored to produce long staple cotton, which requires a much longer growing season for maturity of the crop than short staple requires. Observations made on these isolated places not affected by the flood have borne out the Department's plan of procedure in that the pink bollworm has destroyed a considerable portion of these long staple bolls which required such a long period in which to mature, making hazardous the production of long staple cotton in that area.

The control measures adopted in the Lower Rio Grande Valley of Texas and the area adjacent thereto in Mexico also involve a shortening of the growing season.

Unfortunately it was not possible to secure a shortening of the growing period in 1941. The resultant large increase in pink bollworm infestation in 1942 in the very locality in which it was impossible to obtain a shortening of the growing season in 1941 bears out the soundness of this control method and indicates the importance of following it.

Eradication of wild cotton in Florida for protection of cultivated cotton from pink bollworm: Negative inspection for the pink bollworm in domestic cotton areas in north Florida and southern Georgia continue to give emphasis to the value of the program designed eventually to eradicate the wild cotton from southern Florida. There was no increase in the degree of pink bollworm infestation in the wild cotton plants in southern Florida during the past season. The status of the wild cotton eradication program indicates it is entirely feasible to eradicate eventually that plant from Florida, with consequent elimination of the threat of the spread of the pink bollworm from wild cotton to the main cotton belt. The program continues to emphasize the importance of maintaining pink bollworm infestation at a low enough level to prevent its spread to the main cotton belt pending final eradication of all wild cotton in southern Florida.

Cooperation with the Mexican Government to control pink bollworm infestations to prevent spread into the United States: It was recognized from the very inception of the program to prevent spread of the pink bollworm in the United States that the cooperation of the Mexican authorities would become increasingly important, particularly in the event that the pink bollworm spread into the Lower Rio Grande Valley of Texas and Mexico. Consequently, following the finding of pink bollworm infestation in the Lower Rio Grande Valley of Texas and Mexico in 1936, the cooperation between the Agriculture Departments of the two governments has been intensified. In order to evaluate the cooperative work with Mexico a separate work project was set up to include such cooperative work. This cooperation has consisted in the main of supplying technical advice and transportation where not otherwise available for the officials engaged in carrying out control measures in certain areas along the border. As a result of the cooperation of this Department with the Mexican Department of Agriculture during the fall of 1942 it was possible to secure in some instances the creation of a host free condition in certain fields which offered a distinct menace to the cotton industry of the United States. Joint control programs along the Mexican border are far more effective than would be the case if separate action was taken without reference to the program of the other country because the cotton area is similar on both sides of the border, and, in fact, usually is geographically one area.

SUPPLEMENTAL FUNDS

Direct Allotments

Project	:	Obligations,
	:	1942
Emergency Relief Appropriations: Wild cotton eradication:	:	\$12,752

(p) BEE CULTURE

Appropriation Act, 1943	\$82,100
Proposed transfer in 1944 estimates to "Salaries and expenses, Library"	-2,600
Total available, 1943	79,500
Budget estimate, 1944	75,530
Decrease	<u>-3,970</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Bee culture	\$77,799	\$79,500	\$75,530	-\$3,970 (1)
Unobligated balance	3,796	- -	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	81,595	79,500	75,530	-3,970

DECREASE

(1) The decrease of \$3,970 in this item for 1944 contemplates a curtailment in the work being done at Laramie, Wyoming on bee diseases.

WORK UNDER THIS APPROPRIATION

Objective: To make beekeeping sufficiently attractive and profitable over the widest possible area of the United States to insure that there will be no shortage of bees to pollinate the 50 or more critical agricultural crops needed in the war effort which depend on insects to set fruit or seed, and to utilize fully facilities existing for the production of honey and beeswax. The specific objectives of the research work would be to reduce losses from bee diseases and adverse wintering conditions, to promote better methods of apiary management and to encourage the use of superior strains of bees.

The Problem and its Significance: Every State is more or less dependent upon honeybees as pollinating agents. Beekeeping facilitates the production of almonds, apples, pears, plums, cherries, tung, small fruits, melons, cucumbers, vegetable seeds, cotton, and the seeds of clovers and alfalfa, and aids in the maintenance of pastures and ranges. The beekeeper's income is derived from the sale of honey and beeswax, thus the successful growing of many crops is dependent upon the sale of these products. The production of beeswax, which is a critical material used in the manufacture of munitions, planes and ointments for gas burns, normally is about half the amount required for domestic use. Honey is a wholesome, nutritious food much in demand during the present shortage of sugar.

Beekeeping is practiced in every State. There are in the United States more than 5,000,000 colonies, representing an investment of \$55,000,000, with an annual production of about 200,000,000 pounds of honey, 5,000,000 pounds of beeswax, and about \$500,000 worth of live bees for shipping into honey producing areas. Field studies indicate that honeybees perform at least 80 per cent of the pollination of agricultural crops worth many times the value of the foregoing apiary products.

No matter how well crops are cultivated, fertilized, and cared for, they will not produce full crops without adequate pollination. Providing bees for this purpose is a very practical means of increasing the yields of crops already under cultivation. With the greatly increased acreages and yields necessitated by the war goals, beekeeping must be fostered in every way.

It is necessary that substitutes be found for critical materials used in beekeeping and that beginners and inexperienced persons be properly advised that losses from disease and other causes be reduced to the minimum, that methods of beekeeping be simplified, and that high-producing strains of bees be used.

General Plan: Laboratory and field experiments are conducted in cooperation with State and Federal agencies. The cooperating States are Arkansas, California, Iowa, Louisiana, Oregon, Texas, Utah, Wisconsin, and Wyoming. Disease diagnosis, determination of arsenic in poisoned bees, and information through correspondence are service features made available to all. Problems arising as a result of war conditions are given special attention.

Examples of Progress and Current Program: The current program includes the testing of substitutes for critical materials; determination of factors which influence the value of bees in the pollination of agricultural crops; methods of improving the production of honey, beeswax, and pollen; utilization of pollen and pollen substitutes; the testing and development of breeding strains resistant to disease and having high productivity; and surveys of the prevalence of Nosema disease in package bee areas and arsenical poisoning in fruit areas.

The war demand for full crops of seeds and fruits has focused attention on the dependence of agriculture on the bee industry to fully pollinate the crop acreages. Serious unbalance between plants requiring insect pollination and wild bee population is attributed to: (1) a lack of wild areas suitable for nesting places which have been eliminated by the increase in land under cultivation, by overgrazing, and drainage, (2) the destruction of wild bees before they have opportunity to reproduce by clean cultivation, by spray programs, fast-moving automobiles, brush and grass fires. Recent studies have shown that honey bees perform about 80 per cent of the pollination of certain crops.

"Pollen hunger" can be created in colonies by means of a pollen trap developed by this Division. The use of this equipment to increase the effectiveness of honey bees in crop pollination is indicated by the collection of 20 pounds of rye grass pollen by six colonies in a 10 day period. Grasses are normally wind pollinated, but when honey bees are under stress for pollen, they will collect from many plants not usually worked, such as Timothy, Bermuda and Sudan grasses.

This points to the tremendous possibilities of "compelling" bees to work on those plants which set seed sparingly because of poor pollination under natural conditions. Although bees seldom trip alfalfa flowers, under certain circumstances, shortage of pollen for example, they will work it and can and do effect pollination without tripping. As much as 10 pounds of alfalfa pollen per colony has been obtained by the use of pollen traps.

In many localities, plant sources of fall pollen are so meager that pollen reserves necessary to develop strong colonies for fruit pollination and maximum honey production are not available. The use of soybean flour as a pollen supplement for rearing bees has been developed. Soybean flours produced by the expeller process were found to be superior for this purpose to those produced by the solvent process. Feeding a soybean flour-pollen mixture to colonies in late winter increased the population by as much as 10,000 bees before field pollen became available. Such strong colonies are very effective pollinators for fruit trees and can be used for hive increase and greater honey production.

Supersedure of queens in package bees is responsible for great losses. The reason for the higher incidence of supersedure in package bees than in established colonies has been elusive. However, recent work reveals that many superseding queens have Nosema disease.

The mechanism of resistance to American foulbrood was found to be vested in the ability of worker bees to detect and remove diseased larvae from the colony before the causative organism formed spores. The spore stage of this organism was found to be the only infective stage. Strains of bees resistant to American foulbrood to a high degree are being bred for further experimental work and for field testing by State agencies.

Hybrids of three honey bee races, bred and tested for honey production, showed 10 per cent greater yield than the average of the three pure-bred lines. Close inbreeding over five generations reduced egg viability 51 per cent.

Experiments in methods of increasing beeswax production have shown that dark low grade honey can be converted into beeswax by feeding it back to colonies. It has also been found by producing honey in chunk form and separating the wax and honey by a crush method the usual ratio of 1.2 pounds of wax per 100 pounds of honey can be increased to 7 pounds. These methods hold promise but are not ready for practical use.

(q) INSECTS AFFECTING MAN AND ANIMALS

Appropriation Act, 1943	\$175,105
Budget estimate, 1944	165,940
Decrease (including decrease of \$430 travel funds returned to surplus)	<u>-9,165</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Investigations on insects attacking man and animals ...	\$169,811	\$151,535	\$142,800	-\$8,735
2. Investigations on household insects	15,840	23,140	23,140	- -
Covered into Treasury in accor- dance with Public Law 674 ...	- -	430	- -	- 430
Unobligated balance	2,334	- -	- -	- -
Total estimate or appro- priation	187,985	175,105	165,940	-9,165

DECREASE

The decrease of \$9,165 in this item for 1944 consists of \$430 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$8,735 for the project "Investigations on Insects Affecting Man and Animals," which contemplates discontinuing investigations on lice affecting livestock now being carried on at Menard and Dallas, Texas. Work at these stations on other lines of activity will, however, be continued.

WORK UNDER THIS APPROPRIATION

Objective: To determine the habits of and to develop control measures for those species of insects which transmit disease, such as malaria and typhus to our armed forces and civilian population, annoy men, and attack livestock, and damage or destroy fabrics and food products, particularly the large stocks stored for use by National Defense agencies.

The Problem and its Significance: The role played by insects in the transmission of disease to man and animals in the United States is so important as to make it imperative that the habits and life histories of these disease transmitters be clearly understood so that control measures can be directed at the most vulnerable points in their life cycles. Malaria has always taken a tremendous toll of life, and the loss of efficiency in the Southern States, resulting from malaria, reaches an incalculable figure each year.

Typhus is transmitted by body lice. Both of these diseases take on new importance at the present time because of the activities of our armed forces in regions throughout the world where these diseases are rampant.

Typhus can be controlled immediately when body lice are stamped out, and yellow fever and malaria are brought under control when the mosquitoes that transmit them are destroyed.

Production of beef, mutton, poultry, and wool, mohair, hides and dairy products vital to national welfare is greatly affected by the depredations of many insect pests such as screwworms, biting flies, cattle grubs, and lice. Horse raising and farm operations are also adversely affected by insects such as horse bots, stable flies, and buffalo gnats.

It is highly important, from the standpoint of National Defense, to safeguard all stocks of food, raw and finished products, blankets, clothing, rugs, and upholstery in factories and warehouses. Many millions of dollars worth of fabrics of all kinds are destroyed by clothes moths, carpet beetles, and silverfish; and great quantities of food products are ruined by flour moths, grain weevils, and flour beetles. These losses are suffered annually by procurement divisions of the Federal Government, warehouses, storekeepers, manufacturers, and householders. The insects involved are cosmopolitan, and the losses caused by them affect every individual. Many of the methods now used in combatting these pests are outmoded and no longer adequate to meet the acute and complex problems of National Defense.

General Plan: The work consists primarily of field and laboratory experiments, frequently in cooperation with Federal agencies, State Agricultural Experiment Stations, various control or abatement districts, farmers, livestock associations, physicians, veterinarians, and similar groups. The work is done in 9 laboratories, mostly in the South where medical entomological problems are most acute. Information desired by the Army and Navy on insect repellents, louse control and malaria mosquito larvicides will be furnished mostly by OSRD funds since there are no regular appropriations for these studies.

The work is organized under two financial projects: (1) Insects Affecting Man and Animals; and (2) Household Insects.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited by projects to show progress in one or more aspects of the broader problems involved.

Insects affecting man and animals:

Mosquito investigations: A senior entomologist has given day by day technical advices to the U. S. Public Health Service in its program on control of malaria in war areas. This included the responsibility of training approximately 100 entomologists and 150 scouts, and assigning them to areas where they were needed. Another entomologist served as a liaison officer with the military, and in this capacity visited all of the important camps in

the Southern half of the United States and the corps headquarters in other areas. This enabled the Bureau to furnish to the military specific advice on many problems in widely different localities.

The discovery that an extract of pyrethrum could be used in Freon gas with an activator for destruction of mosquitoes, has been followed by sufficient investigation to develop a suitable bomb type container for commercial distribution. The aerosol bombs are now employed in the program of controlling malaria in tropical regions. This work was done in cooperation with the Division of Insecticide Investigations and with different commercial concerns. One pound of the spray material is sufficient for 150,000 to 250,000 cubic feet of space, is suitable for use in airplanes for preventing infestations from spreading in this manner, and is well adapted for use of troops under combat conditions. This product has been reported by the Surgeon General's Office, U. S. Army, as effective in reducing malaria in the present African campaign.

Recent research has demonstrated a method for sampling soil to determine the exact locations and the intensity of mosquito breeding in salt marshes. The method can be used as a means of measuring mosquito breeding potential by sanitary or drainage engineers. In addition, it definitely shows the specific type of marsh selected by salt marsh mosquitoes for laying eggs. In the Pacific Northwest sod samples are also fairly satisfactory for testing mosquito breeding potential for bottom lands subject to overflow. During the past year a very promising lead has been developed for reducing the amount of oil needed to treat larvae infested water. This is accomplished by adding a wetting agent.

Sandflies: This project demonstrated 88 per cent control for sandfly breeding in a mangrove marsh. This was accomplished by diking and pumping surface water, which permitted drying of the breeding places. Automatic tide gates installed at the lowest points of the dikes facilitated pumping and rapid removal of the water, at a nominal cost. On account of reduced funds, this project was discontinued on July 1, 1942, and only incidental observations and checking on results have been continued.

Ticks affecting man: In order to make investigational work on ticks more applicable to military problems the laboratory at Martha's Vineyard, Massachusetts, was closed and moved to Savannah, Georgia, where information on the seasonal incidence and hosts of ticks that attack man is being gathered as a basis for control.

Clear Lake gnats: Due to a reduction of funds this project was discontinued on July 1, 1942.

Secretions and products of insects: Extract "K" the latest product isolated from fly maggots is being tested on wounds by cooperating physicians and with promising results. Deep-seated war wounds that become infected and resistant to healing, yield to the use of these extracts. The studies include certain types of cell injury and repair which are considered a fundamental work of importance.

Screwworms: In southern Texas where screwworms are active during the winter months, special efforts were made to determine a wound-free period during the months of January and February. This was done so that the pest could

not maintain a big carry-over population to serve as parent flies for 1942. The large scale experiment was not adopted by all ranchmen, but there was sufficient participation to obtain a marked reduction in flies during the spring of 1942. As a result the build-up and spread of the pest was retarded throughout the Great Plains States.

Screwworm Smear 62, a new treatment developed under this project, was used in different areas with gratifying results. Some difficulties were encountered in obtaining a stable product, but it is believed that the improved methods of manufacture will be very helpful. A better method of making turkey red oil was devised. One of the ingredients of the smear, and the new method is now being used in commercial production.

Cattle grubs: During last season derris powders and sprays applied by power sprayers were used effectively for treatment of the larger herds, including range cattle. Wettable sulphur was used as a diluent and as an activator in both methods. It was found that 1 lb. of derris would treat an average of 36 animals, and that a similar amount used as a spray would treat an average of 40 animals. A circular was prepared on these methods for use during the past season, and a campaign is going forward for the control of this pest which adversely affects dairy and beef production and damages hides, all of which items are vital to the war effort. This campaign is carried on in cooperation with the Extension Service and various livestock associations.

Fly sprays: A certain spray material was found to remain on animals and to kill flies for two or more days. The material is critical, however, during the war period. This project was discontinued July 1, 1942.

Ticks affecting animals: Two species of ticks are predisposing causes of screwworm infestations in animals. The Gulf Coast tick attacks the outside ears and some protection has been obtained in experimental treatments made to the ears of animals. The spinose ear tick, which attaches inside the ears, has a distinct tendency to drop on the ground near feed or salt troughs. Preliminary tests used on the soil about the troughs at intervals during the tick dropping season suggest that a fair degree of control may be obtained by such a procedure.

Hornflies: An effective material zinc oxide was found effective in controlling hornflies by feeding it to cattle. This project was discontinued July 1, 1942.

Lice, mites and head bots: A derris dip was found to remain effective in the vat for 18 days and serve for a second dipping of animals for control of the short-nosed cattle louse. This information is of value in our rotenone conservation program.

Dog flies: Technical advice was furnished on a program involving over \$100,000 for control of dog flies breeding in marine grasses along the coasts of bays and inlets of northwestern Florida. This was for protection of the military camps and with funds supplied by them. It was found that sea water from the bays could be used as a diluent for the creosote oil, thereby saving several thousands of dollars on the spray operations.

Investigations of dog fly breeding in celery litter was intensified. It was found that the waste and litter could be treated at the washing plant so that it would not subsequently breed dog flies. Such a procedure will aid in protecting nearby military camps and greatly reduce the numbers of this pest in the celery growing sections of Florida.

Household insects: The need of the armed forces for obtaining tests on fabrics and foods were given first consideration. Yarns with mothproofing agents were tested for the American Red Cross, aviators clothing was tested for injury by clothes moths, and various samples of goods were tested for the Maritime Commission, Federal Trade Commission, Quartermaster Corps, and the Gas Warfare office. Large stores of wool were inspected and advices were given on care and methods of fumigating the warehouses. The storage of food supplies, including several large shipments of coffee were brought to our attention and the necessary fumigations were advised.

A special service was afforded through the visits of our liaison officer to camps on control of bedbugs and cockroaches and several remedies said to be useful in the control of these pests were tested for the Army and Navy.

(r) INSECT-PEST SURVEY AND IDENTIFICATION

Appropriation Act, 1943	\$140,000
Budget estimate, 1944	<u>133,000</u>
Decrease	<u>-7,000</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Insect-pest survey	\$19,756	\$7,000	\$7,000	- -
2. Identification and classi- fication of insects	141,458	133,000	126,000	-\$7,000 (1)
Unobligated balance	1,721	- -	- -	- -
Total estimate or appro- priation	162,935	140,000	133,000	-7,000

DECREASE

(1) The decrease of \$7,000 in this item for 1944 contemplates curtailment of work, involving reduction of personnel in Washington, D. C., on the project "Identification and classification of insects."

WORK UNDER THIS APPROPRIATION

Insect-pest survey:

Objective: To collect detailed information on the occurrence, distribution, ecology, and the relative abundance of insect pests throughout the United States, and to study these data from month to month and year to year with relation to the several factors that influence abundance.

The Problem and its Significance: It is planned to have eventually very complete distributional and ecological information on all North American insect pests, similar information on insects occurring in other parts of the world, and complete lists of the insects affecting any specific plant either in this country or abroad. The results to be obtained from the Survey furnish the necessary foundation for advancement towards entomological forecasting and should throw light on the cause of cyclic and sporadic appearance of insect pests, the gradual shift of regions of destructive abundance, the barriers to normal dispersal, and the directive influences that determine the paths of insect diffusion.

General Plan: This project makes full use of the entomological agencies in the United States. It also studies current conditions of insects in foreign countries through the literature and a few collaborators, in order to be informed in advance of the habits, food plants, and natural enemies of pests that might be introduced into the United States. A monthly Insect Pest Survey leaflet gives the more important current insect developments.

Examples of Progress and Current Program: During the first half of the current fiscal year 3,400 domestic notes were received from collaborators of the survey. These were transcribed and properly filed. Due to loss of personnel the monthly Insect Pest Survey Bulletin was discontinued and in order to give a limited service to our collaborators a 1-page leaflet on the current conditions has been issued each month. During the same period 65 requests were made for extensive Survey information such as requests for complete lists of rubber insects, lists of cereal insects of Europe, and lists of insects which are vectors of tropical diseases. In addition, a large number of requests on specific information have been answered for the several divisions of the Bureau. During this half of the fiscal year the cross-index of the foreign file under the food plants has been practically completed. This makes available immediately information on the foreign pests of any given plant.

Insect identification:

Objective: Identification of insects and allied organisms for the quarantine control and research activities of the Bureau of Entomology and Plant Quarantine, the Public Health Service, and also for the benefit of the military and naval establishments and other federal agencies, state agricultural colleges and experiment stations, pest control operators and private individuals of the United States, as well as for foreign institutions and agencies especially of the Western Hemisphere; and the performance of research in insect classification which must provide the basis for definite and complete identifications.

The Problem and its Significance: There are many hundreds of thousands of different kinds of insects. Numerous species within any given group resemble each other so closely as to appear identical but have entirely different habits, in consequence of which they demand different kinds of control or regulation. Exact identifications of insects are therefore fundamental to research, control and regulatory activities involving them. Such identifications can only be made by experts from specimens that have been specially prepared for study and in many insect groups only after extended search.

General Plan: Practically all the work is performed in Washington, D. C. consists essentially of (a) service activities, involving insect identification and the furnishing of authoritative information on insect classification, nomenclature, habits, distribution and host relationships; and (b) research in insect classification to provide the basis for accurate identifications. Individual specialists are occasionally required to spend brief periods in the field to assist workers on large-scale control or regulation projects in identification problems involved; and visits are made to institutions that are important repositories of insect collections for the purpose of studying special material bearing on research that has been taken.

Examples of Progress and Current Program: During the past 5 years the number of insect samples identified annually has ranged from 57,551 to 77,856. Manuscripts originating in other agencies and referred to this Division for review involved the verification or correction of scientific names totaling 12,000 to 30,000 annually. The Surgeon General's Office is being assisted in the accumulation of information on distribution and habits of insects affecting human health in many parts of the world; and personal assistance and instruction in the identification of mosquitoes and other insect pests of man have been given more than 60 officers of the Army, Navy and Public Health Service during the past year.

Results of research in insect classification performed in this Division are given in published papers. During the past 5 years the number of manuscripts completed and submitted for publication annually ranged from 32 to 52; and the number of printed pages in papers actually published ranged from 624 to 1,013.

Completed work includes research designed to provide a basis for sound identification and control in such economically important groups as the fruitflies; fleas; blowflies; beetles, known in the larval stage as flat-headed borers, which cause extensive damage to trees; white grubs; a large group of minute moths, the larvae of which feed on the foliage of various plants; the horseflies; scale insects frequently encountered in plant quarantine activities; mites, which are important plant pests; carpet beetles; plant lice; and the group of beetles known as raspberry fruitworms. Examples of research projects under way are similar studies in the classification of the chiggers; the weevils comprising the complex known as white-fringed beetles; which are important introduced pests in the southeastern states; the botflies, important pests of cattle and domestic animals; weevil larvae; the blood-sucking blackflies, or buffalo gnats; insect parasites of other insects involved in biological-control programs; bark beetles that are pests of forest trees; whiteflies, which are injurious to many different plants and are serious pests in greenhouses; thrips; powderpost beetles; ants; wireworms that cause important damage to root crops; and leafhoppers that are important plant pests and are involved in the transmission of plant diseases.

(s) FOREIGN PARASITES

Appropriation Act, 1943	\$20,775
Budget estimate, 1944	<u>19,740</u>
Decrease	<u>-1,035</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Foreign parasite introduction	35,905	\$20,775	\$19,740	-\$1,035
Unobligated balance	2,575	- -	- -	- -
Total estimate or appropriation	38,480	20,775	19,740	-1,035

DECREASE

(1) The decrease of \$1,035 in this item for 1944 contemplates a general curtailment of work at the foreign parasite receiving station at Hoboken, New Jersey.

WORK UNDER THIS APPROPRIATION

Objective: To bring about the biological control of insect pests by the importation of their parasites from abroad, thus permitting the more economical production of domestic agricultural crops.

The Problem and its Significance: The great majority of the destructive insect pests attacking agricultural crops in the United States are not native to this country but gained entry from abroad through trade channels. In their countries of origin they are usually not nearly so injurious, often not requiring control measures, and this is due, in many instances, to the parasites that attack them. These parasites did not accompany the pests when they became established in the United States, and consequently the latter were able to increase to destructive levels. Biological control, when successful, is the most economical method, as the first cost is usually only cost, and treatment annually, or several times each year, as in chemical and mechanical control, is unnecessary.

General Plan: To maintain a field station in South America for the study and importation of natural enemies of important crop pests, and a domestic receiving station at which the imported material is handled under strict quarantine conditions until released for field colonization. The foreign station, situated at Montevideo, Uruguay, conducts investigations in all parts of South America, at present principally upon the boll weevil, pin bollworm and stainers of cotton, the sugar-cane moth borer, white-fringe beetle, vegetable weevil, bean beetles, etc. Shipments of parasites are also obtained from other countries through cooperative arrangements, and consignments of American parasites are sent to countries that request them. The parasite receiving station at Hoboken, N. J., receives the imported material under quarantine conditions, eliminates any harmful insects or plant material that may be included, rears the parasites in numbers if required, and then forwards them to domestic field stations for colonization.

The insects for which natural enemies are sought attack a wide variety of

important food, forage and fiber crops. The expenses connection with parasite collection and importation, other than necessary ones of an administrative nature, are provided for from appropriations made for studies on the particular pests. Assistance is lent and good will encouraged among Spanish American countries by exchanging beneficial insects.

Examples of Progress and Current Program:

Since the beginning of the work in South America in 1940, marked progress has been made on several problems. The white-fringed beetle survey has yielded much information on its distribution and habits, which will be of value in work upon that pest in the United States. New parasites, some of them showing considerable promise, have been found upon the cotton boll weevil, cotton stainers, pink bollworm, sugar-cane moth borer, vegetable weevil, bean beetle, etc., and many of these have already been shipped to the United States and Puerto Rico.

During 1942, 39 shipments of parasite material were forwarded to the United States and 14 to Puerto Rico, these comprising 12 species and totalling about 75,000 individuals. Those requiring quarantine handling were forwarded to the Hoboken, N. J., station, the parasites were isolated, improved methods of mass rearing developed, and colonies prepared and forwarded for field release. Shipments of 5 species of American parasites were prepared and forwarded to foreign countries at their request.

(t) CONTROL INVESTIGATIONS

Appropriation Act, 1943	\$66,585
Budget estimate, 1944	63,260
Decrease	<u>-3,325</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Control investigations	\$72,639	\$66,585	\$63,260	-\$3,325 (1)
Unobligated balance	574	- -	- -	- -
Total estimate or ap- propriation	73,213	66,585	63,260	-3,325

DECREASE

(1) The decrease of \$3,325 in this item for 1944 contemplates a reduction in work on the physiology and toxicology of insects and the development of new insecticides. This will reduce the laboratory work being done at Beltsville, Maryland.

WORK UNDER THIS APPROPRIATION

Objective: To find more economical and more efficient materials for the control of insect pests, to develop machinery and methods for the cheaper application of insecticides, and to work out methods of disinfecting commodities under plant quarantine regulations so that they can move freely and safely in commerce.

The Problem and its Significance: The development of insecticides and insecticidal treatments for crops and other commodities for the destruction of insects is an important phase in the production and storage of food plant and plant products and for the treatment of commodities under quarantine regulation so that they can be moved from infested to uninfested regions without danger of disseminating pests.

There is need for new insecticides to take the place of those leaving hazardous residues when applied to edible portions of plants or where the basic materials are widely used in war work or which are of foreign origin and therefore difficult to obtain, or for important insect pests for which no satisfactory insecticide is now available.

More efficient and economical methods for the application of insecticide insecticidal treatments are needed to decrease the cost and allow wider application where the margin of profit in crops is narrow.

This problem necessarily relates to much of the research, control and quarantine enforcement work of the Bureau, and may cut across crop and division lines. In such cases the work is closely coordinated with that done by other units.

General Plan: The work on insecticides consists largely of laboratory investigations on the physiology of insecticidal action and of tests of promising compounds against 10 or 15 insects of economic importance, and tests on plants to determine the effect of the materials upon them. Work on methods of applying insecticides is carried on in shop and field.

The development of treatments for commodities subject to Federal and State quarantines is carried out in the laboratory and field in cooperation with other divisions of this Bureau, or with State and private agencies.

Examples of Progress and Current Program: Investigations on the control fumigation of a series of important crop pests were continued on a large scale. Additional schedules for the Japanese beetle in balled nursery stock, at temperatures of 43 and 46° F., were developed and approved for use. A method for the treatment of nursery stock by the application to soil of methyl bromide in solution was perfected. Additional fumigation schedules for fresh fruit and vegetables were worked out by which commercial shipments can be treated at a wide range of temperatures.

Work was completed on the development of fumigation methods for sweet-potato vine cuttings for control of the sweetpotato weevil, and progress being made on methods of treatment of carload lots of sweetpotatoes, to supplant the present hand inspection.

Fumigation schedules are being developed for the control of the Parlat

scale, a nursery pest occurring only at St. Louis, whereby shipment beyond the infested area may be done without risk of spreading the pest.

Work on the white-fringed beetle consists of the further refinement of vacuum fumigation of balled nursery stock, and one new schedule at a reduced temperature was approved.

Extended tests on the fumigation of imported orchids have yielded satisfactory schedules for the treatment of practically all genera. This method is now being adopted for general greenhouse sanitation.

Methods were developed whereby gasoline-generated heat may be used in the dispersal of insecticidal aerosols of pyrethrum. This supplants the earlier electrically-operated unit, and is especially useful for portable outfits where electric current is not available.

At the direct request of the Army, studies were undertaken of the control by fumigation of lice in soldiers' clothing and equipment. The method developed is highly effective and easy of application, and has already been adopted on a large scale by the Army.

Activities on all of the above lines of work are being continued to further perfect the methods and to apply them to the control of other important pests so that plants, plant products and commodities may be shipped beyond the infested areas without danger of disseminating the pests.

The more fundamental work of insect toxicology and physiology has been considerably reduced in order to concentrate upon problems having a direct war relationship. An effective chigger remedy has been developed and is now being tested on a large scale at army camps. Twenty-six materials were tested as fumigants for bedbugs and two of these proved to be very effective against all stages, and 11 others were more efficient than ethylene oxide, a standard commercial fumigant. Both of these activities are being continued, and work is being started on an investigation of the physiological reactions of mosquito larvae to different insecticides, this being a part of the larger mosquito project now being developed by the Bureau at the request of Army authorities.

Approximately 1500 tests were conducted upon vegetable pests to determine the insecticidal value of more than 250 synthetic organic materials, of which 122 were new. Ten were found to be highly toxic to insects. Twenty-four samples of plant poisons were tested on the Mexican bean beetle, two of which were found to be as effective as commercial derris samples. Three hundred tests, with more than 200 materials, were made upon roaches, and 31 of these showed high toxicity. Fifteen hundred tests were made of substitutes for pyrethrum in fly sprays. Two of these materials showed considerable promise and 14 new materials showed a synergistic action with pyrethrum. This work is being continued on an expanded scale to obtain effective insecticides that will replace the standard materials not now available, or restricted, because of war conditions. In cooperation with the Bureau of Agricultural Chemistry and Engineering, 22 derivatives of domestically-produced nicotine were tested, several of which show considerable promise. Marked progress has been made on the development of insecticidal aerosols, and 265 tests were made. The formula, and method of

application, have been adopted on a large scale by the Army for the control of flies and mosquitoes in airplanes, barracks, etc.

(u) INSECTICIDE AND FUNGICIDE INVESTIGATIONS

Appropriation Act, 1943	\$122,915
Proposed transfer in 1944 estimates to	
"Salaries and expenses, Library"	-2,900
Total available, 1943	120,015
Budget estimate, 1944	113,820
Decrease (including decrease of \$200 travel	
funds returned to surplus)	-6,195

PROJECT STATEMENT

Projects	1942	1943 :(estimated):	1944 :(estimated):	Increase : decrease
1. Chemical investigations on				
insecticides	\$127,341	\$119,815	\$113,820	-\$5,995
Covered into Treasury in accor-				
dance with Public Law 674 ...	- -	200	- -	- 200
Uncbligated balance	874	- -	- -	- -
Total estimate 1944 and				
comparable amounts 1943				
and 1942	128,215	120,015	113,820	-6,195

DECREASE

The decrease of \$6,195 in this item for 1944 consists of \$200 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$5,995, which contemplates the curtailment of investigational work being carried on at Beltsville, Maryland on accessory material for use with insecticides.

WORK DONE UNDER THIS APPROPRIATION

Objective: To improve the chemical materials now employed in controlling insect pests, and to develop new and better ones, in order to insure the production of food of sufficient quantity and grade to keep up with the demands in this time of national emergency, and to safeguard the health of military personnel exposed to infection by insect carriers of disease.

The Problem and its Significance: Insecticides are absolutely necessary for the control of many kinds of destructive insects in the United States, and normally between 100 and 200 million dollars are spent for insecticidal products in an effort to combat the heavy annual loss occasioned by the ravages of these pests. In times such as these many of our standard in-

secticides become scarce for agricultural use because of shutting off of supplies or diversion to military needs. At the same time the need for food production increases and the labor to produce it becomes scarcer. Thus the search for new insecticides and for more effective ones becomes urgent, and investigational work along these lines needs to be intensified.

General Plan: The work consists of the preparation in the laboratory of new insecticidal materials and of both laboratory and field experiments designed to determine the effectiveness and improve the application thereof. All such work is carried out in close cooperation with the other research divisions of the Bureau. Analyses are made of insecticide materials used in experimental and control work by the several divisions of the Bureau.

Examples of Progress and Current Program: Scarcity of standard insecticides have necessitated an intensification of all of the research under this appropriation aimed at developing new materials which will relieve current or impending shortages both in the agricultural and military fields and of devising more economical methods of utilization by the use of additive materials and through physical modifications in the insecticides.

Because the supply of pyrethrum and of rotenone-bearing plants has been greatly reduced or diverted to the use of the armed forces of the country, special effort is being devoted to the search for other plant materials carrying naturally-occurring insecticidal compounds. For instance, an investigation of the occurrence and distribution of anabasine, an alkaloid somewhat resembling nicotine in its action, in the native wild plant known as tree tobacco, Nicotiana glauca, is under way, and assistance is being given in the Department's effort to find out whether the false indigo plant, Amorpha fruticosa, contains enough rotenone to be of any practical significance as an additional source of that important insecticide.

During the past year, an apparatus for determining the particle size of powdered insecticides was described and a United States patent was granted the inventor. By means of this apparatus it is possible to determine in a few minutes the average particle size of any powdered material. The value of this apparatus is apparent when it is realized that the usefulness of insecticides varies greatly with particle size, a finely powdered material being much more effective insecticidally than the same material when coarsely powdered. The average particle diameter of commercial insecticidal sulfurs was determined by the air permeation apparatus. Most of the dusting sulfurs on the market are much finer than the openings in a 325-mesh sieve.

One of the most significant developments in insecticides in recent years has been the finding of improved ways of making insecticidal aerosols. An aerosol is a suspension of colloidal solid or liquid particles in a gas. If the particles are solid, the suspension is called a smoke; if liquid, it is called a mist or fog. Various methods of producing these aerosols were studied. One method consists in spraying a solution of rotenone, pyrethrum extract, orthodichlorobenzene, or other insecticide against a heated surface such as an electric hotplate. A more effective way of forming an aerosol is to dissolve the insecticide in freon (dichlorodifluoromethane) which at ordinary temperatures exerts a pressure of about 100 pounds per square inch. Upon releasing the pressure the solution, which must be kept in a cylinder, escapes into the air. The freon immediately vaporizes, leaving an aerosol

of pyrethrins or other insecticidal material. It has been found that when distributed in this way, 5 or 6 mg. of pyrethrins will kill all mosquitoes a space of 1000 cubic feet. This development is of great importance in the effort to combat insects around military camps and in field maneuvers.

Collaborative work on methods of analysis were carried on for the Association of Official Agricultural Chemists. Two reports were published on micro and semimicro methods for determining Kjeldahl nitrogen.

An important contribution to the cyanide fumigation of citrus trees under tents was made by our workers in Whittier, California. More effective fumigation of scale insects is obtained if the HCN gas is mixed with air by means of a blower before it is introduced under the tent.

The subject of synergism of insecticides has been actively studied in cooperation with other divisions of this Bureau. It was found that sesamin, constituent of oil of sesame, which alone has no insecticidal action, when mixed with a solution of pyrethrins greatly enhances their action upon house flies. The structure of sesamin is known. Compounds of analogous structure were prepared and their synergistic effect with pyrethrum insecticides was studied. Synergists may be synthetic compounds or they may be derived from plants. An example of the latter is asarinin, a constituent of the bark of the southern prickly ash. An interesting byproduct of this research was the finding of another compound in this bark which has insecticidal action.

Improvements in analytical methods were developed; for example, a method of separating nicotine from the related alkaloids, anabasine and nornicotine, and a quick, easy method of determining paradichlorobenzene in nursery treating-soil. Improved forms of apparatus were also developed; for example, a sublimation apparatus and a leaf punch for use in insecticidal residue studies.

Synthetic organic compounds continued to receive much attention as potential insecticides. Chlorofluorene was found to be one of the most effective synthetics against European corn borer. The fungicidal properties of synthetics were also studied, in cooperation with plant pathologists of the Bureau of Plant Industry. The more promising of these include 2,4-diaminodiphenylamine and the copper xanthates.

In cooperation with other divisions of the Bureau improvements were made in the method of applying methyl bromide to the fumigation of nursery plants, and in the preparation of the aqueous solution of this insecticide which is used for the treatment of soil balls for control of Japanese beetle. New materials containing ethylene dichloride and other fumigants capable of spontaneous emulsification when poured into water, were developed for control of soil-infesting insects.

A survey was made of the sodium fluosilicates on the market, and their characteristics compared with those of sodium fluoride, as an aid in the possible substitution of the former for the latter compound, which has become very scarce because of the war, in the making of household insecticides.

Extensive assistance was given to agencies which are responsible for allocation of supplies of insecticides and for the determination of their price,

in studying supplies needed in various areas of the United States for use against the important insects especially on crops under increased production to meet agricultural goals.

(v) TRANSIT INSPECTION

Appropriation Act, 1943 \$41,235
 Budget estimate, 1944 33,940
 Decrease (including decrease of \$250
 travel funds returned to surplus) ... -2,295

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Transit inspection	\$43,900	\$40,985	\$38,940	-\$2,045
Covered into Treasury in ac-				
cordance with Public Law 674 :	- -	250	- -	- 250
Unobligated balance	819	- -	- -	- -
Total estimate or appro-				
priation	44,719	41,235	38,940	-2,295

DECREASE

The decrease of \$2,295 in this item for 1944 consists of \$250 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$2,045 in inspection operations involving a curtailment of seasonal help at various transportation centers where transit inspection is conducted.

WORK UNDER THIS APPROPRIATION

Objective: To inspect in transit, or otherwise, plants, plant products and other materials or articles regulated by Federal plant quarantine, and intercept and dispose of those being transported in violation thereof, to assure compliance of quarantines issued to protect uninfested sections from plant pests injurious to agriculture. To cooperate with States in enforcement of State nursery inspection and crop pest laws.

The Problem and its Significance: Various quarantines and regulatory orders are issued by the Department to prevent the spread of injurious pests such as the white-fringed beetle, the pink bollworm of cotton, Dutch elm disease, white pine blister rust, Japanese beetle, and gipsy moth. The effective enforcement of these quarantines is of great importance and requires that inspections be made outside the regulated areas to supplement and serve as an additional line of defense to the inspection and certification work done

within the regulated areas. Approximately 95% of interstate shipments by common carrier is systematically routed through established and strategically located transportation centers. Inspectors located at such points, through cooperation of employees of the common carriers and state plant pest control officials, can examine and inspect the majority of the shipments containing restricted material. Transit inspection is thus an important second line of quarantine enforcement, supplementing the work done by units within the regulated areas to inspect and certify plants, plant products, and other articles the interstate movement of which is regulated by the quarantines.

General Plan: During the fiscal year 1942, inspection was conducted at 17 transportation centers, nine of which were operated on a seasonal basis. The inspection force consisted of 24 inspectors paid wholly or in part from transit inspection funds and 16 inspectors assigned to assist in the work of cooperating agencies. Very considerable assistance is given inspectors by the cooperation of several thousand mail, express, and freight employees who watch for shipments of restricted materials, segregate and hold them for examination by the inspectors. State cooperative contributions for the fiscal year 1943 will amount to approximately \$18,600.

Assignments are frequently changed, new stations opened, or old ones discontinued to meet the inspection requirements occasioned by changes in quarantines or in regulated areas.

Examples of Progress and Current Program: During 1920, the first year transit inspection was conducted, 12 out of each 1,000 shipments inspected were found to be moving in violation of quarantine regulations; in 1942, this ratio had been reduced to approximately 2 per 1,000 shipments. This illustrates the effectiveness of transit inspection in educating the public to quarantine requirements, a phase of the work which is considered of major importance. Out of a total of nearly 1,400,000 shipments inspected during the fiscal year 1942, 2,842 violations of 8 of the 9 Federal domestic plant quarantines were intercepted with destinations in 48 states, the District of Columbia, Canada, and Puerto Rico. In addition, 1,118 shipments were found to be moving in apparent violation of state pest control and nursery certification requirements and regulations pertaining to the movement of plants into and out of the District of Columbia.

During recent years transit inspectors have intercepted a number of shipments in transit infested or infected with such injurious pests as Gypsy moth, Japanese beetle, the European corn borer and white pine blister rust. If such shipments had been allowed to proceed to their destination new centers of infestation or infection might have become established.

(w) FOREIGN PLANT QUARANTINES

Appropriation Act, 1943	\$719,550
Budget estimate, 1944	682,900
Decrease (including decrease of \$707 travel funds returned to surplus)	<u>-36,650</u>

PROJECT STATEMENT

Projects	1942	1943 (estimated)	1944 (estimated)	Increase or decrease
1. Import and permit service for issuance of permits for the importation of plants and plant products to comply with plant quarantines	\$47,687	\$31,900	\$31,900	- -
2. Inspection at ports of entry of plants and plant products regulated by plant quarantines	657,716	686,943	651,000	-\$35,943 (1)
Covered into Treasury in accordance with Public Law 674	- -	707	- -	-707
Unobligated balance	1,967	- -	- -	- -
Total estimate or appropriation	707,370	719,550	682,900	-36,650

DECREASE

The decrease of \$36,650 in this item for 1944 consists of \$707 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$35,943 for "Inspection at ports of entry of plants and and plant products regulated by plant quarantines," including

(a) A decrease of \$21,943 in maritime port activities which contemplates the curtailment of port inspection work at ports of New York, New Orleans, and Seattle;

(b) A decrease of \$14,000 in activities at Mexican Border Ports which will involve closing the station at Roma, Texas, and reducing activities at Brownsville and El Paso, Texas, Nogales, Arizona, and Calexico and San Ysidro, California.

WORK UNDER THIS APPROPRIATION

Objective: To protect agriculture by administering plant quarantines and regulatory orders, issued under the Insect Pest Act of 1905, the Plant Quarantine Act of 1912, as amended, and the Mexican Border Act of 1942, to prevent the entry of insect pests and plant diseases from foreign countries, Puerto Rico and Hawaii and control and safeguard the entry of plants, plant products and other articles which may carry such pests.

The Problem and its Significance: The estimated average annual loss from introduced foreign insect pests of plants and plant products is \$1,500,000,000. This figure does not include huge annual losses from introduced fungous, bacterial, and virus diseases of plants. Now that the war

effort confronts the nation with the task of meeting the food requirements of the United Nations and assuaging the hunger of the starved peoples in the Axis-dominated territories now occupied by Allied forces, it is vital that every possible effort be made to prevent the introduction and establishment of additional foreign plant pests which could impede the war effort through further reduction of food supplies and the crops otherwise needed for the prosecution of the war.

World commerce has been disrupted by the war, and current conditions in new problems of foreign plant quarantine enforcement through the substitution, for normal commercial commerce, of abnormal lend-lease commerce and the movement of the ships and aircraft, troops, and supplies, of the armed forces. The exigencies of the latter movements create a set of problems peculiar to the situation which necessitate intensive supervision of the personnel and work, and constant adjustment of emphasis to meet the kaleidoscopic changes occurring from day to day.

Receipts: During the fiscal year 1942 receipts of \$30,604 resulted from fee of \$4.00 a car charged for fumigating railroad cars entering this country from Mexico. This fumigation is required as a safeguard against the introduction of insects attacking cotton. Estimated receipts from source in 1943 are \$32,000.

General Plan: Under the Plant Quarantine Act most kinds of plant propagation materials, fruits, vegetables, cotton lint and related products, cereals, etc., may be imported only under permit, subject to inspection, and in some instances supervised disinfection, sterilization, etc., at the point of entry. Permits to import serve to bring the importations to the attention of the plant quarantine inspectors who are located in the principal maritime, and Canadian and Mexican Border ports of entry who, in cooperation with Customs, inspect vessels, trains, and aircraft from foreign countries, their stores and passengers' and crews' quarters, passenger baggage, cargo, and with the further cooperation of the Post Office Department, mail, for the presence of injurious plant pests or the means of carrying such pests. In Hawaii and Puerto Rico the movement of certain plants and plant products to the mainland is supervised, and certain products are treated under supervision for the prevention of the movement of injurious pests with these products. The work is organized under two general headings, Import and Permit, and Port Inspection, and is conducted at a cost of less than 1/2000 of the estimated annual loss from introduced insect pests alone.

During the fiscal year 1943, cooperation from States and Territories amounted to \$143,050, the major contribution being from California and Florida.

Examples of Progress and Current Program:

Import and Permit: During the fiscal year 1942 the permit service was moved to the field and placed under the general direction of the official in charge of the plant inspection House at Hoboken, New Jersey. At the same time the personnel assigned to this work was reorganized for purposes of increased efficiency. As in previous years, emphasis continues to be placed on the simplification of permit procedures to facilitate prompt

inspection or other handling of importations by the inspectors at ports of entry. During the war many adjustments have had to be made to meet the exigencies of abnormal commerce--such as safeguarding distress cargoes landed in coastal areas where, because of pest risk factors, these cargoes would not be permitted to land under normal conditions.

Although there has been a decrease in normal foreign commerce with certain countries, new problems are constantly arising in connection with commerce with other countries occasioned by the dislocations due to the war. This necessitates a continual study of the possibilities for safeguarding against pest risk in connection with the importing problems thus presented, which entails considerable correspondence with the public and the inspection personnel concerning the regulations and the provisions for importation thereunder. It must be emphasized that shipments brought to this country without previous authorization may involve considerable delay and unanticipated expenditures, with possible losses to the importer, and the preliminary arrangements of permits and correspondence not only assist the importer in preventing such losses, but have the more important functions of arranging for entry under safeguards against unusual pest risk which these importations so often present.

Port inspection: Since the inception of the work in 1913 the inspection force has not been numerically adequate to make desired thorough inspection, and emphasis during recent years has been placed more and more on increasing the efficiency of the existing personnel through training and improvement of inspection techniques and the utilization where practicable of advanced treating procedures.

The exigencies of the current war effort have superimposed upon the normal problems of safeguarding foreign arrivals against the introduction of insect pests, additional problems more than sufficient to offset any reduction in normal foreign commerce. The arrival of vessels in large convoys rather than in a normal steady flow creates serious personnel problems because of the lack of inspectors sufficient to handle the work at such peak periods. At one port it was necessary to assemble as many as 84 inspectors from points as much as 100 miles distant to supplement a normal staff of 16, many of whom worked continuously for from 24 to 36 hours. A recent survey has shown that the average number of inspector-hours required for the inspection of a vessel has approximately doubled since war was declared. Because of a lack of information regarding previous inspections while a vessel was in coastwise movement, it was necessary to inspect 92 percent of the vessels arriving at ports in the United States during fiscal year 1942, while in fiscal year 1941 it was only necessary to inspect 87 percent. In cooperation with the War Production Board, and in an effort to meet the urgent requirements of certain mills manufacturing strategic materials and located in the Northeastern part of the United States, procedures were inaugurated, involving field supervision contrary to the usual practice, which permitted the direct movement from pier to mill of long staple foreign cotton for immediate utilization under plant quarantine supervision and safeguards.

Increased traffic with Mexico occasioned by war activities requires the inspection of many additional freight cars and the fumigation of increased numbers of cars contaminated with cottonseed to prevent the further introduction of the pink bollworm into the cotton growing areas of the country.

Eleven thousand and seventy-nine, or 25 percent more, freight cars were inspected in the fiscal year 1942 than in fiscal year 1941; and 3,914 more cars were fumigated than in the fiscal year 1941--representing an increase of 97 percent. Vessels of friendly nations arriving for repairs present new problems with respect to stores and cargo, such as a foreign vessel which recently made a southern port and was forced to discharge nearly 1,100 bales of foreign cotton while torpedo damage was repaired.

The problem of having inspectors available for the arrival of airplanes from foreign countries, and from Hawaii and Puerto Rico at mainland ports is further complicated as the number of these arrivals increase and their airports of arrival are dispersed. In the fiscal year 1942 there were 1,707 more airplanes inspected than in the preceding year--an increase of 25 percent. That airplane arrivals currently continue to increase is illustrated by the increase of 740 airplanes (115 percent) for the first quarter of the fiscal year 1943 over the comparable quarter in 1942.

(x) CERTIFICATION OF EXPORTS

Appropriation Act, 1943	\$30,710
Budget estimate, 1944	29,180
Decrease	<u>-1,530</u>

PROJECT STATEMENT

Projects	1942	1943 :(estimated):	1944 :(estimated):	Increase : decreases
1. Certification of exports ...	\$31,867	\$30,710	\$29,180	-\$1,530
Unobligated balance.....	220	--	--	--
Total estimate or appropriation	32,087	30,710	29,180	-1,530

DECREASE

(1) The decrease of \$1,530 in this item for 1944 contemplates the curtailment of activities at New York.

WORK UNDER THIS APPROPRIATION

Objective: To inspect and certify shipments of plants and plant products offered for export to meet the sanitary requirements with respect to insect pests and plant diseases of the foreign countries of destination, thereby enabling exporters to comply with conditions of importation into such countries without which the importations would be prohibited.

The Problem and its Significance: In recent years many foreign countries have imposed additional requirements governing importations of plants and plant products and have increased their enforcement of existing sanitary requirements. The growers and exporters of this country have faced loss of markets without strict inspection and adequate certification of their exports of plant materials. War has intensified this situation. Under the provisions which have been made annually in the Appropriation Act of the Department of Agriculture commencing in 1927, this activity has enabled the growers and exporters to meet these requirements and save their markets if the conditions of their shipments warranted the required certification. With the closing of markets in war-ridden Europe, exporters are seeking new outlets for their surpluses and this service now becomes an even greater aid to them in shipping products which will satisfy the entry restrictions of the countries in which the new markets are located. Exportations are now also made to Central and South American countries in line with the inter-American program for meeting the agricultural requirements of the United Nations.

Receipts: Receipts in the amount of \$3,819 were collected during the fiscal year 1942. The \$1.00 fee charged for each certificate issued was not collected from agencies of the Federal government. Estimated receipts from this source in 1943 are \$3,800.

General Plan: This work is performed largely in conjunction with port inspection activities under the appropriation for Foreign Plant Quarantines, since export certificates may be issued at any of the various ports where plant quarantine inspectors are stationed. The work is so organized that State-Federal inspection personnel operating under the Apple and Pear Export Act, enforced by the Agricultural Marketing Administration, assist in the inspection at shipping point of apples and pears in order that they may also meet the sanitary requirements of the countries of destination. Such sanitary shipping-point inspection is supervised by designated employees of this Bureau during the shipping season.

Examples of Progress and Current Program: Most of the countries in which the United States has leased defense bases maintain and enforce plant quarantine import restrictions. The War and Navy Departments have evidenced a desire to observe the regulations of those countries when shipping food and other supplies to those bases. To meet the emergency demands for the inspection of these supplies at the port of embarkation, emphasis has been placed on this phase of the work to make inspection and certification promptly available upon demand by the armed services.

With the outbreak of the war in Europe, there was a marked decline in export shipments, particularly in certain fruits. New foreign markets are being found and present indications point toward some increase in the number of shipments exported in 1943 as compared with 1942, which will consist of larger numbers of containers. In the fiscal year 1942 the average number of containers per certificate was 33.8 as compared with 27.8 containers in the fiscal year 1941.

(y) CONTROL OF EMERGENCY OUTBREAKS OF
INSECT PESTS AND PLANT DISEASES

During the fiscal years 1942 and 1943 an appropriation of \$1,750,000 was made

available as follows:

Sixth Supplemental National Defense Appropriation Act, 1942,
approved April 28, 1942:.....\$1,750,00

Of the amount available, \$295,631 was obligated during the fiscal year 1942 leaving a balance of \$1,454,369 available for obligation during the fiscal year 1943.

The Budget for 1944 includes no request for an appropriation under this item. It is expected, however, that an estimate of funds required to carry out the purpose of the authorizing legislation for the season of 1943 will be submitted for consideration in connection with a deficiency appropriation act. It is generally recognized that information that may be assembled regarding the status of plant pests which may occur in emergency outbreaks, such as grasshoppers, Mormon crickets, chinch bugs, etc., during the season when they are active gives a reasonably satisfactory basis on which an estimate of funds may be made. Such information is not available until late in the fall and considerably after the time when regular estimates are prepared. It is also recognized that plans and operations for the control of incipient and emergency outbreaks of plant pests have to be made and carried out on the basis of crop rather than fiscal years. For effective work, funds that are provided should, therefore, be available early in the calendar year.

WORK UNDER THIS APPROPRIATION :

Work under this appropriation is conducted on the basis of a crop season rather than a fiscal year. It is therefore not practicable to report on the work under this item on the basis of a fiscal year. The following briefly summarized the activities which have been conducted with funds made available under the authorization for the control of incipient and emergency outbreaks of plant pests. None of the appropriations made under this authorization have been carried in regular Acts providing funds for the Department.

Public Resolution No. 20 (75th Congress) authorized an appropriation of \$2,000,000 for the control of incipient and emergency outbreaks of insect pests and plant diseases, including grasshoppers, Mormon crickets, and chinch bugs. It also authorized that the funds appropriated should remain available until expended and the appropriation of such additional sums as might be necessary to replenish the fund to its original amount at the beginning of each fiscal year.

Public Resolution No. 91 (75th Congress) amended this legislation by removing the limitation of \$2,000,000 and authorizing the appropriation of such amount as might be necessary. Ten appropriations have been made under these authorizations, as follows: Two of \$1,000,000 each, the first by Public Resolution No. 26, approved April 27, 1937, and the second by Public Resolution No. 81, approved July 17, 1937; one of \$2,000,000 by Public Resolution No. 81, approved March 2, 1938; one of \$700,000 by the Second Deficiency Act, fiscal year 1938; one of \$3,000,000 by the First Deficiency Act, fiscal year 1939; one of \$1,750,000 by Public Resolution No. 22, approved June 15, 1939; one of \$2,500,000 by the First Deficiency Act, fiscal year 1940; one of \$800,000 by the Second Deficiency Act for the same year; one of \$2,225,000 by the First Deficiency Appropriation Act, 1941; and one of \$1,750,000 by the Sixth supplemental National Defense Appropriation Act, 1942. Of these appropriations

but the last one have expired; this remains available until June 30, 1943.

The great part of the funds provided by these appropriations have been used to enable the Department to cooperate with States in combating widespread outbreaks of grasshoppers. The funds have, however, made it possible to take active measures on a large scale against a newly established pest, the white-fringed beetle, as well as against the Mormon cricket. Also, from year to year, work has been done against other pests, which, although less widespread, are nevertheless serious threats to important agricultural commodities.

In this latter group, control activities were carried on during the 1942 field season against the pear psylla, the chinch bug, the mole cricket, the scale insect Parlatoria Chinensis and the Hall scale.

SUPPLEMENTAL FUNDS
(Complete bureau statement)

Direct Allotments

Projects	Obligations : 1942	Estimated ob- ligations, 1943	Estimated ob- ligations, 1944
<u>Emergency Rubber Project:</u> For work			
on insects affecting Guayule	- -	9,346	26,420
<u>Special Research Fund:</u> Effect of			
artificial control practices on			
natural enemies of insect pests ..	15,433	15,700	- -
<u>Allotment:</u> Regular Item for White			
<u>Pine Blister Rust Control:</u>			
Planning, coordination, and			
technical direction of blister:			
rust control	388,752	450,150	450,150
Blister rust quarantine enforce-			
ment	10,100	10,000	10,000
Cooperative control of blister			
rust on State and private			
forests	82,290	268,290	268,290
Total, White pine blister			
rust control	481,142	728,440	728,440
<u>Emergency Relief Appropriation Acts:</u>			
Barberry eradication	379,375	- -	- -
Eradication of the Dutch elm			
disease	628,201	- -	- -
White pine blister rust control:	404,192	- -	- -
Control and prevention of spread:			
of gypsy moth	199,258	- -	- -
Peach mosaic control	55,969	- -	- -
Phony-peach disease control	64,438	- -	- -
Citrus canker eradication	20,504	- -	- -

Projects	Obligations : 1942	Estimated ob- ligations, 1943	Estimated ob- ligations, 1944
Wild cotton eradication	\$12,752	- -	- -
Planning and review of W.P.A. projects	3,510	- -	- -
General administrative ex- penses	71,670	- -	- -
Total, Emergency Relief Appropriation Acts	1,839,869	- -	- -
Removal and Reestablishment of Arlington Farm (Entomology and Plant Quarantine)	81,950 *	- -	- -
Working Fund, Agriculture, Ento- mology and Plant Quarantine (Ad- vance from Commodity Credit Corporation Capital Fund)	15,535	16,000	- -
Working Fund, Agriculture, Ento- mology and Plant Quarantine (Ad- vance from Air Corps Army)	- -	62,000	- -
<u>Working Fund, Agriculture, Ento- mology and Plant Quarantine, Agricultural Research Adminis- tration (Advance from Salaries and Expenses, Office for Emer- gency Management):</u>			
Human Lice Investigations	7,026	39,774	- -
Insect Repellents	19,853	60,000	- -
Larvicide Investigations	- -	35,800	- -
Total, advance from Office for Emergency Management	25,879	135,574	- -
TOTAL SUPPLEMENTAL FUNDS (Direct allotments)	2,460,808	967,060	754,

* Available until expended.

PASSENGER-CARRYING VEHICLES

No estimate is submitted for the purchase of passenger-carrying vehicles for the Bureau of Entomology and Plant Quarantine in the fiscal year 1944.

It is planned to continue 281 old vehicles in operation during 1944.

AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF AGRICULTURAL CHEMISTRY AND ENGINEERING

(a) GENERAL ADMINISTRATIVE EXPENSES

Appropriation Act, 1943	\$106,044
Proposed transfer in 1944 estimates to	
"Salaries and expenses, Office of	
Administrator, Agricultural Research	
Administration"	-4,000
Total available, 1943	102,044
Budget estimate, 1944	102,044

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
General administration and				
business service	\$102,064:	\$102,044 :	\$102,044 :	--
obligated balance	3,136:	-- :	-- :	--
Total estimate 1944 and comparable				
amounts 1943 and 1942	105,200:	102,044 :	102,044 :	--

WORK UNDER THIS APPROPRIATION

This appropriation provides for administrative supervision and direction of the work of the bureau, to carry on the business activities necessary for the proper functioning of the organization as a whole, including personnel, budget, book-keeping, auditing, purchase and property, editorial and information, files, and miscellaneous services and records.

(b) AGRICULTURAL CHEMICAL INVESTIGATIONS

Appropriation Act, 1943	\$349,251
Budget estimate, 1944	348,557
Decrease (travel funds returned to surplus)	<u>-694</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase : decrease
1. Cereals, fruits, vegetables, and other agricultural products	\$118,751:	\$126,545	\$126,545	-
2. Sugars, sirups, and oils investigations	101,822:	105,687	105,687	-
3. Protein and nutrition investigations	27,519:	28,854	28,854	-
4. Basic investigations in chemistry, microbiology, and pharmacology of agricultural products	62,750:	65,985	65,985	-
5. Chemical weed eradication investigations	10,429:	6,240	6,240	-
6. Enzyme action in agricultural products	14,843:	15,246	15,246	-
7. Pilot plant investigations on soybean meal and oil	19,764:	-	-	-
Covered into Treasury in accordance with Public Law 674	-	694	-	-\$694
Unobligated balance	9,964:	-	-	-
Total estimate 1944 and comparable amounts 1943 and 1942	365,842:	349,251	348,557	-6,588

WORK UNDER THIS APPROPRIATION

Objective: To devise means of reducing deterioration and spoilage of agricultural commodities between harvesting and processing, during storage, and after processing, and to find means of preventing deterioration of foods feeds which must be stored under emergency and war conditions; to develop methods of processing, preserving, and packing foods to meet the requirements of war conditions; to develop needed feed supplies from farm by-product materials not heretofore fully utilized; to assist by chemical and technological means in developing "deficiency" crops (e.g., tung nuts for tung production) for supplying products for which existing supplies are inadequate.

The Problem and Its Significance: The importance of food in winning the war is generally recognized. The existing situation requires the solution of problems of processing, packaging, transportation and storage of food products which are radically different in many respects from those prevailing under ordinary conditions.

Thus, the shortage of refrigeration facilities on boats carrying food to Great Britain has necessitated development of methods of preservation not ordinarily employed. Increased need has developed for dehydrated and compressed foods, both for military use and for lend-lease shipment, with emphasis on better retention of color, flavor, and vitamins and (for military use) reduction in time required for rehydrating for cooking. Dehydration of foods conserves tin, reduces shipping weight, and prevents certain forms of spoilage. Necessity for building up reserves of food supplies in certain areas, including Great Britain, emphasizes the importance of keeping quality and of precautions for minimizing deterioration in storage after processing and packing. Large Government purchases of food necessitate chemical, bacteriological, and technological study of many problems arising in connection with processing, packaging, and keeping quality in meeting new conditions and situations. The great increase in army camps, especially in the South, has intensified the already existing need for more and cheaper winter feed for dairy cattle in that area. Shortage in some products is necessitating development of substitutes.

Assistance along these and similar lines is being rendered under this work program. Solution of many of these problems will have peace time benefits. Thus, the lend-lease shipment of food products of satisfactory quality may be expected to pave the way for new and expanded export markets. Solution of the problem (intensified by war conditions) of more and cheaper winter feed in the South will have permanent results in better nutrition and greater crop diversification in that area.

General Plan: In general, basic work is conducted in Washington and applications are made at 12 field stations located in areas where production of the crops involved is greatest. The entire appropriation is being applied to work of the character indicated. Cooperation is maintained with the Army, Navy, National Research Council for Defense, Agricultural Marketing Administration and other bureaus of the Department, and state agricultural experiment stations.

Examples of Progress and Current Program: The following examples of recent accomplishments under this appropriation are cited to show progress on one or more aspects of the broader problems involved. Other aspects of these problems indicate the next logical steps to be taken in the research program.

Cereals, fruits, vegetables, and other agricultural products: In order to save storage and overseas shipping space (and possibly improve preservation) for military and emergency use, work was conducted on compression of flour. A satisfactory method effecting about 50 percent reduction in

shipping space was devised and is being developed further in cooperation with the Navy Department. This method is being applied to compression of other food products for overseas shipment. An improved method, resulting in better quality and greater yield, has been developed for production of soybean milk. When reduced to dry form, this product will serve as a space-saving, high-protein concentrate for lend-lease shipment and military use. Research to determine the effect of deterioration of stored wheat and flour on baking quality indicated the range of storage temperature which can be employed without damage.

Because of lack of refrigeration on most overseas boats and shortage of tin cans, a special method of processing, preserving with sulphur dioxide, and packing citrus (grapefruit and orange) fruit base and noncitrus fruits in barrels was developed, and technical and chemical assistance in use of the method was rendered to processors. This method, with suitable modifications for each fruit, was used last season for packing strawberries, raspberries and peaches for overseas shipment and for producing and packing about 60,000,000 pounds of the citrus fruit base for lend-lease shipment to Great Britain to supply the "jam ration" of the British Ministry of Food. Research was conducted on means of reducing the volume of the product without sacrificing extraction of pectin from the fruit, and, as a result, overseas shipping space required was materially reduced. Because of present short supply of pectin, a method was devised for processing and drying citrus pomace (residue from juice extraction) for lend-lease shipment to Great Britain as a source of pectin. This method has been tested successfully at a factory scale and a sufficient number of processors are prepared to begin requirements. Because of greatly increased consumption of jellies, jams and marmalades by United States military forces, it is expected that this source of pectin will also be used in the United States. A method was developed for production of apple base marmalades (in mixture with various frozen fruits) and work was conducted on improvement of production process to insure better keeping quality and greater retention of vitamins in concentrated citrus juices (orange, lemon, lime) for lend-lease shipment.

About 2,000,000 gallons of 95 percent alcohol can be produced annually from the waste liquor available from citrus residue drying plants in Florida. A method for producing alcohol from this liquor was devised and a distillery (constructed principally from second-hand materials) of 6,000 gallons alcohol daily capacity for utilizing same is being erected in Florida. The distillery will supply alcohol to nearby smokeless powder plants in the South.

In cooperation with the Western Regional Research Laboratory, investigations of the preservation of vegetables by dehydration are under way. These studies are of considerable importance to the Army, Navy, and lend-lease agencies, and are under the direction of the Committee on Dehydration of the Bureau of Agricultural Chemistry and Engineering.

Under present conditions of short supply of steel and tin for manufacture of cans, limited production capacity for glass containers, and shortage

rubber closures for same, it is imperative that alternative means of preserving vegetables be investigated and developed to a practical basis. The method of brining and controlled acidic fermentation used for preserving cucumbers has been successfully modified and used for other vegetables, such as onions, peppers, and string beans. When debrined and cooked, these products were of excellent quality. It appears that this method of preservation might supplement dehydration to advantage. Cucumber pickling plants, which are located in many areas not adequately served by canning factories, are in a position to undertake preservation of vegetables by this method and would require little new equipment (principally wooden tanks). Products would be shipped in wooden barrels. This method meets exceedingly well the economic requirements of the war situation and does not require skilled labor and metals (e.g., for boilers, motors, blowers, etc.) as in alternative preservation methods. Some cucumber pickling plants are situated in fresh vegetable shipping areas and might handle "end-of-the-season" vegetables, i.e., portions of crops grown for fresh shipment and available after early season shipments have moved, with advance of the season, to points farther North. Work is being conducted on preservation of a number of vegetables by this method.

Sugars, sirups, and oils investigations: Necessity for holding about 50 percent of the sugar beet crop in storage for approximately 40 days annually results in loss of sugar at the rate of about one pound per day per ton of beets, amounting to 200,000,000 pounds or more annually. Tests were conducted on use of sodium hypochlorite and other disinfectants in conjunction with coating of beets in storage piles with lime or filter press cake. Results indicate that by these methods it may be possible to reduce this loss 50 percent or more, thus increasing sugar supply.

Work was conducted on a process for recovery and purification of sugarcane wax as a by-product of sugar production. The operation of the process on a semi-industrial scale was successful and commercial production is planned. Extensive tests show that sugarcane wax is a satisfactory replacement for ozokerite and montan, carnauba, candelilla, and Japan waxes, now unavailable or available in insufficient quantity. Tests made by commercial users showed that sugarcane wax can be employed satisfactorily for various critical purposes, such as: Waterproofing and lubrication of cartridges and artillery shells; waterproofing and lubrication of marine cordage; waterproofing tents, ponchos, and canvas airplane covers; for electric cable and wire insulation; as an expander and blending agent in molding rubber articles; as finish for leather; and in production of plastics. Considerable quantities of carotene (provitamin A) are obtainable as a by-product in purification of the wax and work is being conducted to recover this vitamin material.

The process developed for production of sugar from sorgo was operated on a semi-industrial scale and yields up to 175 pounds of sugar per ton of sorgo were obtained. As by-products there were obtained per ton of sorgo an average of: 10 pounds starch, 4 pounds aconitic acid, 1 bushel seed heads, 6 gallons molasses, and 400 pounds residual bagasse. The methods of separating starch and aconitic acid were improved. Compounds of the latter are valuable as plasticizing agents for production of plastics (needed to conserve critical metals) and as extenders in molding of rubber.

Because of submarine sinking of tankers and insufficient supply of blackstrap molasses, and in order to supply New Orleans distilleries with raw material produced nearby, the Department of Agriculture sponsored a program for growing sorgho in Louisiana for production of sirup as raw material for alcohol manufacture. About 25,000 tons of sorgho were processed. Adequate supply of this material obviates necessity for using labor and steel to manufacture corn milling and processing equipment to permit use of cereals by these distilleries and avoids taxing transportation facilities for shipment of corn from a distance. This plan utilizes sugar factory equipment during the idle season for processing the sorgho. The process used by the sugar factories for processing sorgho is an outgrowth of the work done on development of the sorgho sugar process (see foregoing). Chemical and technical direction was given to the sugar factories in the processing of the sorgho. Results of this season's work indicate that sugar factories, instead of processing sorgho sirup, might ferment sorgho juice and distill it to medium proof alcohol by use of their evaporating equipment, such alcohol being then shipped to distilleries for further concentration. If this possibility is confirmed by a factory-scale trial, it is possible that continental sugar factories might produce, during their off-season, some 100,000,000 gallons of alcohol annually for manufacture of explosives and synthetic rubber.

Investigation was made to develop methods of preparing coffee-sugar tablets suitable for use by the Army as a means of rapid preparation of coffee, either by individuals or by groups.

In cooperation with the War Department, a method was developed whereby troops in the field can make adhesives from certain plants occurring in various war areas, such adhesives to be used for attaching vegetation and soil camouflage to military equipment (tanks, trucks, artillery, etc.).

Concentration of military camps in the South has increased greatly the demand for milk, the supply of which in many sections has not been adequate in the past for even the normal population. A serious "bottleneck" in meeting this increased demand for milk (and also meat) in the South is the inadequate supply of winter feed available. Shortage of winter feed, particularly of carbohydrate feeds, in the South results in considerable measure from low yields of corn in that area. In view of the fact that sweetpotatoes, which thrive well in the South, are capable of yielding tons of starch (the principal carbohydrate of both sweetpotatoes and corn) per acre in that area, as compared with about 1.4 tons per acre from corn in the Corn Belt and about 1.25 tons per acre from white potatoes in Maine, work has been conducted on commercial and farm-scale methods of dehydrating sweetpotatoes for use as winter feed. Feeding tests with sweetpotato meal conducted by several southern agricultural experiment stations with beef cattle, dairy cattle, hogs, sheep, and mules, gave favorable results. Efforts are being made to develop a low-cost farm-scale method for dehydration of sweetpotatoes, using both culls and sweetpotatoes grown specifically for this purpose.

Because of the serious shortage of drying oils and at the request of the Production Board, a program for installation of the process of solvent

extraction of tungoil (in two new plants) developed in previous work is being formulated with the objective of putting it into effect during the next processing season. This program will substantially increase domestic tungoil production and will release a certain percentage of tungoil presses and expellers which can be transferred to soybean areas for handling increased oil production. Tests of the process have been conducted in cooperation with manufacturers of solvent extraction equipment and it is anticipated that it will be possible finally to extract oil direct from the ground tung nuts instead of expeller press cake. Since the number of solvent extraction plants would be smaller than the number of tung oil mills, it will be necessary to haul tung fruit from a longer average distance. In order to reduce this adverse factor, work is being conducted on a method of hulling tung fruit at the groves, using preliminary treatment with ethylene gas. In this way the weight of material to be hauled to the processing plants would be reduced approximately 50 percent. Work was conducted on production of gas mask carbon from tung shells.

Protein and nutrition investigations: Studies made on the effects of storage of grains upon the chemical properties and nutritive value of their proteins and vitamins show marked decreases in solubility, digestibility, and nutritive value thereof. It has been shown that yellow corn may lose 50 percent or more of its original vitamin A value. The protein value of corn put in storage soon after harvesting was found to decrease significantly. Samples of wheat, on the other hand, stored for several years in Kansas were found to have a nutritive value (with respect to protein) sufficiently high to indicate that no serious deterioration had occurred during the period of storage. Because data on its value before it was placed in storage (controls) were not available, a strict comparison cannot be made. Other samples of wheat of the 1942 crop from Iowa, Kansas, and North Dakota were fed soon after they were put in storage. Later, at different intervals of storage, samples of these wheats will be fed in order to determine the extent of storage changes.

Studies during the past year showed that the use of soybean, peanut, and cottonseed flours offers one of the most effective, economical, and practical ways of meeting the shortage of protein foods and that this may best be accomplished by their use in conjunction with wheat flour. The proteins of peanut, cottonseed, and soybean flours were found to have four times the protein value of white wheat flour. The growth-promoting value of white flour can be increased twofold by protein supplementation with 10 parts of peanut or cottonseed flour and fourfold with soybean flour.

Basic investigations in chemistry, microbiology, and pharmacology of agricultural products: In order to correct the serious shortage of protein in food rations in Great Britain, the dried egg industry of the United States, under the program of lend-lease purchase, has expanded from a capacity of about 10,000,000 pounds to about 400,000,000 pounds annually. The number of egg drying plants has increased from 18 to over 100 and, in addition to supplying Great Britain, shipments to Russia and expanded use by the United States Army and Navy and by civilians in the United States are contemplated. This enormous increase in production, together with entry

into this business of many concerns which have had no previous experience, has resulted in numerous problems of technological, bacteriological, and chemical control, solution of which is necessary in order to insure delivery of products of uniformly satisfactory quality, and to make certain that deterioration and spoilage do not occur in transit and during storage in reserve supplies. Using a portable laboratory, examination of the equipment, technical procedure, and intermediate and final products of a considerable number of these plants has been made and, on the basis of such study, recommendations (which have usually been followed) regarding desirable improvements in procedure and equipment have been made. A large number of samples of egg products has been investigated bacteriologically, not only with respect to degree and source of bacterial infection and presence of bacteria of the colon-aerogenes group, but also with respect to presence of bacteria of food spoilage and food poisoning types. Rigid control is particularly necessary in view of use of dehydrated eggs in diets of convalescents, infants, etc.

Storage tests have been made to determine permissible range of temperature. Studies have been conducted on suitability of various types of packages for shipment overseas and to climates of high humidity. Because of shortage of tin for producing the customary type of container used in the cold storage of broken eggs (prior to drying), and necessity of selecting alternative suitable containers, investigation was made of a considerable number of iron and plywood containers. Important basic facts regarding rate of conduction of heat through such containers and eggs, and the effect of temperature at time on bacterial growth, were developed. These studies showed that containers of certain types could be used satisfactorily and that the dimensions of the containers are of primary importance.

Investigation was made of procedures used for canning boned chicken for shipment to hospitals and convalescent centers in Egypt and the Near East. Bacteriological investigation was made with respect to micro-organisms of food spoilage and other types resistant to processing. Certain contaminating products were found to be under-processed. Storage tests were conducted for purpose of determining permissible range of temperature in relation to time of storage.

Investigations previously conducted in pharmacology were discontinued and the chemists engaged in same conducted work for increasing retention of vitamins in dehydrated vegetables.

In order to supply more winter feed in the South to permit increased milk production (now needed in greater quantity because of concentration of military camps in that area) work was conducted on production of silage from cull sweetpotatoes and sweetpotato vines, using silos of about 10-ton capacity. In some cases other materials, such as apple waste, available at the same time of year, were added. Samples taken from the silos at regular intervals showed that the fermentation and curing processes were proceeding satisfactorily. Later in the winter the silos were opened and feeding to (cooperation with the North Carolina Experiment Station), using dairy

cattle, were conducted with satisfactory results. It is anticipated that in this way the available winter feed supply of the South can be increased at little cost, i.e., by preserving material now largely wasted. It is planned to continue this work, using other combinations of feeding materials with cull sweetpotatoes and sweetpotato vines.

Advances in infra-red and color photography have tended to outmode older methods of military camouflage. In infra-red photography the chlorophyll green of natural vegetation and surfaces of mineral or synthetic organic composition appear in certain identifiable colors. There are other related differences making it possible to detect camouflage of certain types by aerial photography. Although the United States Army has made progress in development of camouflage paints, none are completely satisfactory. Because of these and other considerations, the War Department has emphasized the importance of improving camouflage technique with devices based on natural vegetation.

In cooperation with the War and Navy Departments work has been conducted on development of portable mats of living vegetation, the bottoms of which are composed of chemically treated fabrics of suitable characteristics. In some situations moisture availability and retention are important limiting factors for stability of living vegetation in camouflage mats. Certain western range grasses have been found to persist under moisture and temperature conditions unfavorable for growth of grasses commonly used in regions of relatively ample rainfall.

Experience gained in previous work on the adverse effects of industrial contaminants (gases, mists, and dusts) on crops has been applied to development of anti-camouflage technique. Because of differences in response of different plant species and of freshly cut green foliage as compared with living foliage, it is believed that camouflaged enemy positions can be disclosed by release of certain gases in suspected localities. Color and infra-red photographs have been taken of fumigated and unfumigated plants to test the photographic as well as visual response of various plant species to such treatment.

Chemical weed eradication investigations: The hardiness of weeds and their ability to maintain life and color under adverse environmental conditions point to their availability as preferred plant species for use in camouflage mats of living vegetation. Work on chemical eradication of weeds has, therefore, been shifted to utilization of weeds for military camouflage. The mat base is chemically treated to retard mildew and other types of decomposition. Two or more species of weeds may be employed to produce varying shades required for matching color tints. Mats have been developed which are tough and durable and which can be moved about with little injury.

By subjecting weeds (and other vegetation) to chemical action, various necessary color effects can be obtained, to harmonize with the prevailing color of buildings. By spraying with these chemicals, it is possible to achieve camouflage, mottled protective coloration effects over a considerable area of vegetation.

Enzyme action in agricultural products: A new protein isolated from wheat has been found to be poisonous to yeast. At the request of the War Production Board, experiments were conducted to determine whether or not this substance was causing some distillers to have trouble making industrial alcohol under the wheat-alcohol plan. It was found that the bad effect of this constituent of wheat on the distillers yeast may be overcome by increasing the amount of yeast used and also by adding certain yeast nutrients. This explains why some distillers have not had trouble while others have. Another method of avoiding this yeast poison in wheat (by modifying the malt) is now being studied. The information is of immediate value to the wheat-alcohol program.

Work has been done in collaboration with the Bureau of Plant Industry on an enzyme that destroys cotton. The enzyme is produced by a mold and enables the mold to rot the fabric (for instance, in sandbags) without actually being in contact therewith. The final object of these experiments is to determine methods of preventing the action of the enzyme, as well as of the mold itself, on the fabric. Another object is to use enzyme preparations to test various fabrics for their resistance against rotting, because such tests are much quicker than those now employed.

Pilot plant investigations on soybean meal and oil: In the Second Supplemental National Defense Appropriation Act, 1942, \$20,000 was provided for intensifying research on (1) a process for obtaining from soybean meal a valuable protein replacing imported casein in paper coatings, adhesives, textiles, and other materials required in both military and essential civilian activities, and (2) a method for fractionating and chemically treating soybean oil, producing fast-drying oils to replace those formerly imported, for making paints, varnishes, and other protective coatings on military and other equipment. Studies were made on the type of equipment required for refining of soybean protein. Specifications were drawn up for the required apparatus, submitted for bids, and the contracts awarded for its purchase. Design work on the liquid-liquid extraction equipment was completed and orders were placed for the necessary apparatus.

Based upon the studies and developments on this work during fiscal year 1942, equipment is being assembled for carrying out both processes on a pilot plant scale, to approach as closely as possible the operating conditions that will obtain in commercial practice so that the developments can be put into industrial operation as soon as possible with a minimum of risk.

The assembly and operation of apparatus developed on these studies are being expedited at the Northern Regional Research Laboratory, to which the chemical phases of soybean utilization investigations were transferred effective July 1, 1942.

(c) AGRICULTURAL ENGINEERING INVESTIGATIONS

Appropriation Act, 1943	\$323,733
Second Supplemental National Defense	
Appropriation Act, 1943	30,000
Proposed transfer in 1944 estimates to	
"Salaries and expenses, Library"	-5,400
Total available, 1943	348,333
Budget estimate, 1944	297,504
Decrease (including a decrease of	
\$829 in travel funds returned to	
surplus)	-50,829

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Advice and assistance	\$20,997:	\$21,300	\$21,300	- -
Farm mechanical equipment	97,962:	99,181	99,181	- -
Farm structures and related	:	:	:	:
investigations	62,856:	61,195	61,195	- -
Mechanical processing of farm	:	:	:	:
products	79,471:	160,751	110,751	\$-50,000 (1)
Rural electrification	:	:	:	:
investigations	21,903:	5,077	5,077	- -
covered into Treasury in accordance	:	:	:	:
with Public Law 674	- -:	829	- -	-829
obligated balance	30,030:	- -	- -	- -
Total estimate 1944 and comparable	:	:	:	:
amounts 1943 and 1942	313,219:	348,333	297,504	-50,829

DECREASES

The decrease of \$50,829 in this item for 1944 consists of \$829 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$50,000 under the project "Mechanical processing of farm products", including:

(a) A decrease of \$20,000, due to the elimination of a nonrecurring item provided for in 1943 for the construction of a water tower fire protection system at the United States Cotton Ginning Laboratory, Stoneville, Mississippi.

(b) A decrease of \$30,000, which contemplates the completion of cotton-cutting machinery investigations, for which \$30,000 was appropriated in the Second Supplemental National Defense Appropriation Act for the fiscal year 1943.

CHANGE IN LANGUAGE

The estimates include proposed changes in the language of this item as follows (new language underscored, deleted matter enclosed with brackets):

****; for giving expert [advise] advice and assistance in agricultural and chemical engineering; for collating, reporting, and illustrating the results of investigations and preparing, publishing, and distributing bulletins, plans, and reports, [~~\$323,733~~, of which amount not to exceed \$20,000 shall be available for the construction of a water tower fire protection system at the United States Cotton Ginning Laboratory, Stoneville, Mississippi.] \$297,504, together with the unobligated balance of the funds made available under this head for the fiscal year 1943 for the construction of a water tower fire protection system at the United States Cotton Ginning Laboratory, Stoneville, Mississippi, to be available for the same purpose in 1944.

The first change is merely a grammatical correction of the verb form "advise" to the noun form "advice," the latter being the correct usage as employed in the language.

The second change amends the authority for the construction of a water tower fire protection system at the United States Cotton Ginning Laboratory, Stoneville, Mississippi, for which \$20,000 is provided in the 1943 appropriation as a nonrecurring item, to make available during the fiscal year 1944 a part of the \$20,000 appropriated in 1943 as remains unobligated at the close of the fiscal year 1943. This change contemplates the continuation and completion, during fiscal year 1944, of this construction project, which has been delayed because of difficulty of acquiring the necessary materials and equipment.

WORK UNDER THIS APPROPRIATION

Objective: To determine the basic principles governing the efficient performance and use of farm power, machinery, and equipment; improve existing and develop new types of farm machinery adaptable to the physical characteristics of farm land and for the growing of staple and special war crops; design and study requirements of better farmhouses and also buildings and equipment for processing and storing farm products and housing animals; to study the engineering problems of cotton ginning, fiber flax processing and of sansevieria growing and primary processing; to extend the uses of rural electrification; to give advice and assistance in agricultural and chemical engineering; to prepare, publish and distribute bulletins, building plans and other farm engineering information.

The Problem and Its Significance: The existing war situation emphasizes the need for increased agricultural engineering aid to farmers in solving their primary problems such as technical guidance in the utilization of farm machinery and power, both mechanical and electrical; directing farmers how to keep their farm structures in a serviceable condition with the minimum

use of critical materials; converting existing structures for emergency use and how to operate their buildings and equipment with less labor and replacements; solving problems involved in cotton ginning to secure cotton more acceptable by war industries; developing methods to improve the packaging of American cotton and to reduce the amount of shipping space required; harvesting and processing of fiber flax so as to stimulate domestic production by reduction of costs and of sansevieria as an additional source of fiber for the manufacture of binder and marine cordage to replace former imports of hard fiber; and dissemination of information on these projects.

The efficient use of farm power and machinery is of particular importance during the emergency because of the national food production program confronting the farmer. This calls for increased crop and livestock production in the face of growing labor shortage, and the restricted availability of new machinery which for 1943 has been set at 20 percent of the 1940-1941 average.

A material aid to the solution of the problem is to make the most effective use of existing power and machinery, and this requires determination of the basic factors governing the most efficient performance of the many types of equipment for production of the essential crops. The importance of the efficient use of such machinery is reflected, for example, in the need for most careful use of critical chemicals applied as fertilizers for increasing crop yields, and as insecticides and fungicides for controlling the ravages of insect pests and plant diseases in growing crops.

The national program calling for increased farm production and the shortage of materials, equipment, and machinery for replacements require the most effective use and preservation of existing facilities and buildings.

Prior to the war, farm buildings, due to the depression, depreciated until many were of little service. This, with the expansion of the livestock program, the establishment of the ever-normal granary, the need for storing large quantities of special products to replace products formerly imported, and the shortages of common building materials and equipment, have placed a serious strain on the ability of the farmer to produce and store food for the armed forces and domestic consumption and to make up for deficiency of produce needed for the manufacture of basic war materials.

Increased quantities of long staple upland cottons and very long staple American-Egyptian (irrigated) cottons have been planted in 1942 and are anticipated for further increase in 1943. War demands are focused upon obtaining maximum utility from quality high grades in cotton, to which end Government premiums are aimed, making low grades of cotton undesirable and an actual obstacle to national needs. This situation has required an intensifying of research work in cleaning, extracting, drying, and other ginning processes in order that the greatest possible amount of cotton may be ginned to meet war requirements. Research in cotton ginning is aiding associated objectives such as synthetic cotton linters from surplus stocks, substitute war materials in cotton gin repairs and modernization, and new engineering methods which enable ginners to eliminate equipment orders upon war loaded

factories. The results of the cotton ginning investigations reach approximately 11,000 active cotton gins, each of which on the average is patronized by about 150 cotton producers.

Fiber flax, a nonsurplus and noncompetitive crop in the United States, is used for a variety of purposes, such as, the manufacture of fire hose, shoe thread and harness, twines, and is one of the preferred materials for webbing and shrouds for parachutes. The 1942 acreage is estimated as sufficient for producing only about 20 percent of prewar domestic consumption of raw flax and linen goods. Fiber flax differs from many of our field crops in that it requires special processing operations usually performed in rural areas where flax is grown. An increase of over 100 percent in the acreage planted to fiber flax this past season over the previous season makes the development of new machinery and processing plants of especial importance in making available the finished product at the earliest possible time for our country's needs.

With the completion of the research on hemp processing machinery, permitting application of the results of research to production phases, fiber from our domestic sources is being sought to more nearly fulfill the wartime and peacetime requirements of fibers for cordage and twine. Sansevieria, which can be grown in the southern part of this country, produces a good hard fiber but no processing equipment has been developed. The aim of the sansevieria investigations is to find or to develop a satisfactory method of processing this fiber, either by adaptation of machines already in use for other fibers or by development of new machines, so that an additional source of high quality fiber for the economical production of binder twine and cordage may be had to replace manila hemp which, because of the war, we are no longer able to import.

In the use of electricity which has rapidly been extended to all classes of farms, and has materially aided in improving living conditions, emphasis is being placed on the adaptation of this type of power to aid in the food production program.

General Plan: In general, the basic work, as well as its practical application is carried out at 13 field locations in areas where farm crops, machinery, and buildings are of the greatest importance (two stations dealing with farm houses have been discontinued for the duration and an additional station is to be established in Florida to study the engineering problems involved in the growing and processing of sansevieria for hard fiber). The information thus acquired is applied direct or is made available through the Washington office for dissemination where it will best aid the war effort.

Examples of Progress and Current Program:

Advice and assistance: The Bureau has cooperated with the Extension Service in the development of programs and subject matter on agricultural engineering for extension use. Advice and assistance has been furnished to low-income farmers, through cooperative work with the Farm Security Administration, on the efficient and economical use of power and machinery on cooperative farms to increase the production of food, feed, and fiber and prolonging the life and service of farm power and machinery.

The current program includes assistance to the War Production Board, to other war agencies, and to the purchasing agencies of our Allies in furnishing information and estimates concerning power and machinery, building supplies, and other critical materials or needs.

Farm mechanical equipment: In continuation of the insecticide fungicide dusting equipment investigations studies were made on the abrasive properties of a large number of dust formulas. In an effort to correct the erratic delivery of the dusts from duster nozzles, determined last year, and to reduce excessive abrasion, two experimental tractor-mounted dusters were constructed for study in the control of blight diseases on sugar beets and canning tomatoes. Preliminary tests indicated considerable promise.

Fertilizer placement machinery studies showed that deep placement of fertilizer in a band in the bottom of each furrow when plowing the land was an advantageous method in tomatoes in one location and that the use of a nutrient starter solution in addition to the usual fertilizer application resulted in more rapid recovery of plants and prospects for increased yields of tomatoes, in another location. Field trials with single row planters indicated that the usual separate operations of marking the rows, applying the fertilizer, bedding the land and planting the seed can be accomplished by a "once-over" machine, thereby reducing horse-hours by 64 percent and man-hours by 70 percent.

Sufficient progress in the development of a sugar beet harvester had been made to justify a manufacturer building 15 units for this fall's harvest. A reduction in man-hour requirements from 33 when following common practice to about 7 man-hours when using one of these machines was noted in the field scale test.

At the Tillage Machinery Laboratory, a castor bean huller of about 50 bushels per hour capacity was developed and five such units constructed by the Commodity Credit Corporation for use this fall. An experimental peanut digger which lifts the peanuts and shakes off the soil was developed. Field tests indicate considerable promise.

An experimental sweet corn picker was developed to a point where the ears could be harvested without excessive bruising although clogging in the snapping rolls gave some trouble. Some exploratory studies were made in the harvesting of alfalfa by several different methods. Storage studies showed that bales having the usual density of 9 pounds per cubic foot and 16 percent moisture had no tendency to heat, while bales having a density of 12 pounds heated to a maximum of 100° F. two weeks after storage.

To facilitate handling sweetpotatoes, crate-holding attachments were mounted on the experimental sweetpotato harvester and a field cart devised to handle these crates. The developments resulted from the growing scarcity of burlap bags.

Extensive field tests were made with some 15 different substitute binder twines with corn and grain binders. These twines included lightweight sisal

and hennequen, paper, and paper-sisal combination and several strengths of cotton and a cotton sisal combination. The most promising twine tested so far appears to be the cotton-sisal combination.

Plans are under way to make exploratory studies of the engineering problems involved in mechanizing the growing and harvesting of sansevieria, an additional source of hard fiber, for the manufacture of binder twine and marine cordage.

Farm structures and related investigations: Studies of winter and summer comfort of farmhouses in Wisconsin and Georgia, respectively, have been dropped during the war and efforts directed to protection of farm buildings from fire; insulation of structures for conserving fuel; utilization of farm by-products for insulation; and to the construction, repair, and conversion of farm buildings for essential war needs.

Attention has been given to methods of blacking out poultry houses and dah barns along the sea coasts so that production of the animals will not be affected by lack of ventilation and light. Assistance is given the Office for Agricultural War Relations as to the minimum of critical materials required for the orderly functioning of farm production so that the War Production Board can be advised in establishing adequate priorities. Advice on handling farm produce in Latin-American countries is supplied to the Office of Foreign Agricultural Relations.

Studies of structural, ventilation, and environmental requirements for safe storage of ear corn on the farm have shown that down draft or pressure ventilation causes the circular crib to perform as well as the conventional crib. Steel bin manufacturers are interested in using this type of ventilation, as soon as steel is again available, because circular bins can be manufactured more economically. Considerable spoilage occurs in commercial cribs 6-1/2 feet wide when the corn is cribbed with a moisture content above 23 percent. Ear corn under fully exposed conditions dries 5 to 10 times as fast as corn in a crib, thus showing the difference in the rate is due to amount of ventilation. High moisture shelled corn can be dried by natural ventilation in bins 4 feet wide; this method appears satisfactory for grain sorghums and soybeans.

The expansion of the peanut crops, as a source of essential oils, has involved solving problems of providing suitable storages. Unprocessed peanut hulls and a fabricated board made of peanut hulls are being tested to determine their value and economy for insulating farm buildings in the South. Also, the insulating value and fire resistance of cottonseed hulls have been determined.

Potato storage houses built in accordance with our recommendations developed in Maine, Michigan, and North Dakota have permitted better holding practices and protection of the structures from condensation which rots the structural members. In Nebraska, the introduction of tight bins has resulted in more and better seed and table stock potatoes at the end of the season in the crop area; further work is necessary to secure more uniform bin temperatures.

by manual and thermostatic control. Tests to delay sprout emergence of seed stocks for the South are under way in several storages comparing crate and bulk storage.

In Colorado the special problems of potato storages in the High Plains area are studied in houses built according to our recommendations, to improve table stock for winter marketing and seed stock for June planting and to convert bag storages to bulk storages on account of war shortages of bags. Small cellars for storing products of victory gardens are being developed.

Results of shipping early potatoes indicate that browning and subsequent scald occur only in bruised portions and the damage depends upon the time of exposure to the sun. A comparison of best types and treatments of bags to use for shipping potatoes and effect on potatoes is being made; also, the effect on potatoes of different methods of cooling cars en route to market is being studied.

The Delicious and other types of apples are not only a food, but their successful raising and holding is an industry from which an appreciable number of farmers depend on for a living. Work is being done to determine how best use can be made of existing cold storage facilities and how this crop can be handled to secure the maximum efficiency from facilities that cannot be replaced or expanded at this time.

A bulletin on the disposal of farm sewage, which will establish more positive and uniform rural sanitary practices, has been prepared in cooperation with the United States Public Health Service.

Mechanical processing of farm products: In connection with the cotton ginning investigations, approximately 700 intensified research tests in saw and roller ginning in the central and southwestern states were conducted during the fiscal year 1942. A home-made effective small drier-cleaner-extractor for one and two-stand cotton gins of the southeast was developed to enable them to modernize at low cost and with nonwar materials. Engineering work on old models of gins was accomplished toward production of greater capacity and higher quality for extending the service of such gins for the duration. A number of gin fire replacement investigations was made for the War Production Board. A home-made planting seed drier was tested in the agricultural war program for fiber and food, to aid in preserving staple cotton seed for planting. New methods of cleaning ginned lint before baling are being tested. Tests on methods for gins to use in supplying clean seed and linters are under way. Cutting of cotton fiber into war linters was done on preliminary runs at Stoneville, Mississippi, in the Cotton Ginning Laboratory.

Several factories are constructing flax processing machines developed by the Bureau, which are now available in the open market. One machine, constructed for combining the operations of harvesting, removing the seed from the straw, cleaning the seed, and forming the straw in bundles tied with two bands ready for the retting tanks, harvested about 30 acres the past season with encouraging results. An experimental two cleaner placed in one plant processed

over 100 tons of tow which otherwise would have been unsalable. This brought an added return to the processing plant and placed on the market a material vital to war needs. The availability of complete plans for new flax mills as prepared by the Bureau made possible the construction of four new plants with a minimum of delay. This was essential from the standpoint of growing lack of critical materials, as well as completion in time for processing season's crop.

To alleviate the acute shortage of certain fibers, formerly imported, a study has been made of existing hemp processing plants and all available information collected and coordinated for the processing of domestic hemp into fiber. Plans and specifications for a hemp processing pilot mill, with improved drying kilns and better dust collection facilities than have been heretofore available have been prepared. These research results have been made available for an expanded program of domestic hemp production and processing.

As a further means of alleviating the shortage of hard fibers, particularly for making binder twine and cordage, it is proposed to study existing processing machines to determine which, if any, are adapted to processing sansevieria and what adjustments or modifications may be necessary in each case to adapt a machine to this new fiber. From such a study it may be possible to develop a design for a new processing machine which will make the excellent fiber available for war needs.

The Chemical Division of the War Production Board has urged the need of insuring adequate supplies of cotton cellulose for the manufacture of smokeless powder and has requested the Bureau of Agricultural Chemistry and Engineering to continue its research studies to develop a satisfactory commercial pilot plant size cotton cutter to cut cotton to lengths which can be used by purification plants. Work is now under way to design and build a cutter. Detailed plans and drawings have been made for the cutter and auxiliary opener and feeder units. Arrangements have also been made to secure adequate quantities of cotton for the cutting tests. The sum of \$30,000 was appropriated for this work in the Second Supplemental National Defense Appropriation Act, 1943.

Rural electrification investigations: In connection with the rural electrification research activities, three series of studies designed to compare the quality of eggs when kept in an egg cellar, under water in a spring, in a burlap curtain cooler, in a refrigerated room with forced circulation, and in a room cooled by an evaporative screen were recently completed and the data are now being analyzed.

The major program of research on rural electrification has been suspended in favor of investigations to make possible increased production of hard fiber from domestic sources (hemp and sansevieria).

(d) NAVAL STORES INVESTIGATIONS

Appropriation Act, 1943	\$118,456
Budget estimate, 1944	<u>112,100</u>
Decrease (including decrease of \$366 travel funds returned to surplus)	<u>-6,356</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
Investigation of naval stores production, processes, and equipment	\$38,266	\$39,956	\$38,966	\$ -990 (1)
Investigation of the composition, properties, components, and deriva- tives of naval stores	34,615	35,267	34,267	-1,000 (1)
Investigation of uses, handling, and transportation of naval stores	31,964	39,867	38,867	-1,000 (1)
Construction and improvements at Naval Stores Station	- -	3,000	- -	-3,000 (2)
vered into Treasury in accordance with Public Law 674	- -	366	- -	-366
Obligated balance	11,760	- -	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	116,605	118,456	112,100	-6,356

DECREASES

The decrease of \$6,356 in this item for 1944 consists of \$366 decrease in travel funds (returned to surplus in 1943) and:

(1) A decrease of \$2,990, which contemplates a reduction in the estimates for equipment and supplies required for prosecution of these projects, and includes a decrease of \$90 due to curtailment of distribution of a publication in accordance with Office of War Information regulations.

(2) A decrease of \$3,000 due to the elimination of a nonrecurring item for an improved fire protection system for the Naval Stores Station, Olustee, Florida.

WORK UNDER THIS APPROPRIATION

Objective: To increase the usefulness and fields of use of naval stores, particularly to develop products from naval stores that are vital for war purposes; specifically to conduct research on improved methods of production, on substitution of critical materials normally required in naval stores plant

operation by noncritical materials to help meet the increased emergency need for naval stores and on the development of new and diversified products for naval stores for war purposes now and to serve later as a means of building a more satisfactory post-war economy than has heretofore prevailed, thus improving the economic status of the increasing number of low-income farmers in the South.

The Problem and Its Significance: Of special significance at the present time are problems dealing with the utilization of naval stores and its derivatives to meet such specific war requirements as the development of derivatives useful in making synthetic rubber, resins, plastics, driers, and drying oils; products for rot-proofing of sandbag and military fabrics; and derivatives useful for special military purposes such as flame throwers, incendiaries, smoke screen materials and smokeless powder.

The acute rubber situation has created an increasing need for "intermediates" for making synthetic rubber and various chemicals and derivatives needed in the compounding of such rubbers, particularly for making military and heavy duty tires and other manufactured rubber goods. Turpentine derivatives have been obtained which can serve in actual rubber synthesis both individually and in compounding products to impart to synthetic rubbers specifically desired properties.

Pine oleoresin is the source of raw materials for synthetic rubber, protective coatings, for drying oil promoters, soap, various chemicals, such as camphor, cymene and styrene derivatives, and other chemicals vital for war needs. It is abundantly available, annually reproducible crop with potentialities for increased production.

To meet the increasing demand for naval stores due to war requirements will require, in view of the scarcity of labor and the difficulty of obtaining equipment involving critical materials, the development of improved processing and suitable equipment from available structural materials. The increasing shortage of metal containers for naval stores products necessitates study of methods of collecting pine gum, of grading and evaluating and of packaging, storing, and handling of rosin and turpentine, its principal commercial products.

General Plan: The research and technical work under this appropriation is being conducted in the field and at the Washington laboratories as follows: Studies on production, processes, and equipment are carried on at the Naval Stores Station, Olustee, Florida; studies on composition, properties, components, and derivatives; and uses, handling, and transportation of naval stores are carried on in the laboratories at Washington. Results obtained from studies on composition and derivatives constitute a basis for studies on new uses and applications, particularly as these affect the war effort. Wherever possible, results obtained from studies on composition and new uses are translated into larger than laboratory scale work at the Naval Stores Station. Some of the specific war problems under study are carried on at Washington and vicinity, in close cooperation with the Corps of Engineers, Quartermaster Corps, Chemical Warfare Service, and other war agencies.

The appropriation for "Naval stores investigations" is devoted to work connected directly or indirectly with the war program, but as far as possible also with the view to their effect on the development of a sound post-war economy in the naval stores industry.

Examples of Progress and Current Program:

Investigation of naval stores production, processes, and equipment:

Technical assistance was given producers in rebuilding and resetting twenty-two fire stills and in the design and construction of five central distillation plants; also in the design and construction of pine oleoresin processing and refining plants. This process is now in operation in four commercial plants. A mineral acid washing process for refining pine oleoresin, especially for removal of iron, has been developed, data on which have been published and an application for a service patent made. An entrainment trap has been designed to remove rosin usually carried over with the turpentine vapor during distillation. Tests have been made on a commercial steam still, built according to the design of this Bureau, which showed a high efficiency at low steam pressure, requiring but three hours for running three charges, while normally, by the fire still, two and one-half to three hours per charge are required. The war has caused an increase in the requirements for naval stores, while the industry is faced with a shortage in labor and restrictions in material and equipment used in production for processing. With increased demand, a great increase in the number of small farmers engaged in producing gum for sale to central stills has come about, all of which makes the need for Government assistance and advice to farmers and processors of naval stores more acutely necessary.

Some of the fields in which research and commercial adaptation investigations are being pursued are: Construction of, and development of data on pilot scale continuous gum cleaning and processing equipment with the view to replacement of the less efficient batch processes now in use; substitution of nonstrategic metals for stainless steel and aluminum in design for central plants; construction of, and development of data on pilot scale equipment for mineral acid process for gum purification; development of suitable coatings for turpentine containers to replace tin containers previously used; the development of suitable preserving agents for wooden rosin barrels during storage; the development of protective coatings for black iron rosin drums to substitute galvanized iron drums formerly used; development of paints suitable for coating of old turpentine cups essential in the conservation of strategic metals; development of methods of gum grading; through cooperative agents, to render assistance to gum farmers and naval stores producers, to assist in meeting the production goal set by the Secretary, by increasing production of turpentine and rosin.

Investigation of the composition, properties, components, and derivatives of naval stores: In connection with the investigations on the thermal treatment of a- and b-pinene, the two main components of turpentine, derivatives have been obtained which possess valuable properties useful in the synthetic rubber, synthetic resin, plastics, and drying oil fields. Practical tests by commercial laboratories on some of these derivatives have

shown that myrcene in particular can serve in rubber synthesis. Isoprene is already in use for butyl rubber and for certain "neoprenes." Rubbers of excellent properties have been made with myrcene by copolymerization with butadiene, styrene, and isobutylene, respectively, the latter figuring prominently in the national synthetic rubber program. Myrcene has also been found useful in making certain rubber cements, essential in production of barrage balloons and rubber rafts. On the basis of preliminary tests with our process for myrcene, one manufacturer of such rubber products is now constructing a pilot plant estimated to produce twelve tons of myrcene rubber per month, and established a cooperative development-research project with the Massachusetts Institute of Technology which is to work out plans for quadrupling plant capacity as soon as operating data on the first plant becomes available. Further expansion is contemplated depending upon availability of raw material. The source for myrcene is β -pinene, one of the major components in gum and sulphate wood turpentine, the compositions of which were studied and shown to be excellent sources for β -pinene.

In connection with the investigation of resin and rosin acids, a method has been developed for the preparation of certain viscous liquid rosin polymers which have some drying properties and may be useful in the drying oil and protective coating fields. In connection with investigations on thermal treatment of α -pinene, a service patent application has been made for a product rich in allo-ocimene which may serve as a combination paint thinner and potential drying oil.

In connection with the work on thermal derivatives from turpentine, improved methods and pyrolysis apparatus (simplification and improvement over the old apparatus) have been developed. Purification of these derivatives, which depends wholly on fractionation, is a matter of prime importance for their use in rubber synthesis. In this connection, improved apparatus have been developed and designs for their construction and data on their operation have been published. These include: (1) A new highly efficient fractionating column, (2) an apparatus for control of reflux rate by photo-electric nanostatic means, and (3) an apparatus for control of reflux ratio. Both rate and ratio have an important bearing on efficiency. Some of these apparatus designs constitute bases for applications for service patents with a view to their use on an industrial scale.

Phases of research and commercial adaptations investigations being pursued include: Investigation of methods involving extraction and azeotropic distillation applicable to purification of myrcene (intermediate for rubber) order to supplement or substitute the present and only means of purification (vacuum fractionation), which entails a number of practical difficulties; development of improved methods for the production of isoprene, already in use in synthetic rubber manufacture and the use of which may increase enormously if made adequately available (see Baruch Rubber Report); investigations, in connection with rubber laboratories, of derivatives suitable for use as compounding, plasticizing and tackifying agents to impart special properties to synthetic rubbers with a view to elimination or reduction in the amounts of natural rubber (10-20 percent) at present, apparently indispensable in the manufacture of military and heavy-duty tires; study of

methods of stabilization and polymerization of rosin acids for preparation of derivatives that may supplement and replace "fossil gums" shellac and other imported natural resins; investigation of methods for the production of isomerization derivatives applicable to the drying oil field as promoters for semi-drying oils which will have to be used more and more to meet the growing needs of the drying oil field; methods for the development of resins suitable for curing concrete and methods for the development of non-glyceryl esters of rosin or rosin derivatives (particularly lactic acid and butylene glycol esters) which may serve as supplements, substitutes and perhaps preferable materials over glyceryl esters (ester gum) in the protective coating field.

Investigation of uses, handling, and transportation of naval stores:

As a result of a study on mixtures or blends of copper naphthenate with the copper salts of rosin and liquid rosin ("tall oil") for preserving sandbag fabrics, it has been found that the naphthenic acid, now becoming increasingly short, can be conserved by replacing about 1/4 of the amount of naphthenic acid normally used by liquif rosin. The Corps of Engineers has approved the use of such combinations for treating sandbag fabrics. Promising results have been obtained in the treatment of fabrics by precipitated copper resinate for rot-proofing. Simulated grass camouflage mats have been developed for the Navy Department by treating cotton yarns and sisal fabrics with flame-proof infra-red reflecting compositions.

Data have been furnished to the Chemical Warfare Service on means of improvement and modification of flame throwers by the use of ammonium soaps. A study of the reaction of rosin with lime has been completed, which indicates the conditions under which practical limed rosin with specific properties may be produced. A varnish having a good water resistance and other promising properties has been made from rosin-lactic acid reaction product and a bodied linseed oil. Zinc resinate prepared under certain conditions has been found to give promising results for a concrete curing composition. Promising results have been obtained in preparing lead resinate paint driers. Assistance was rendered in preparing Federal specifications for bar, flake, and granular soaps containing 20 percent rosin, thus affording a means of replacement of coconut oil with rosin. Tests on the treatment of wooden rosin barrels with sodium silica fluoride and para nitrophenol have shown such barrels were protected against rotting for over two years.

Annual and semi-annual reports on production, consumption, and distribution of turpentine and rosin and related products have been issued. Statistical data on other naval stores, requested by war agencies, have been collected.

The current program of research investigations include: In cooperation with the Corps of Engineers, and in collaboration with the Southern Regional Research Laboratory, to continue the study of the use of naval stores products for preserving sandbag and other fabrics for military use, with the view of further supplementing or replacing naphthenic acid which is becoming less available; in cooperation with the Quartermaster Corps to investigate the use of naval stores for treating fabrics for military use other than for

sandbags; to cooperate with the Chemical Warfare Service in investigating use of naval stores products for improving flame thrower fuels; to continue the study of resinate paint driers to cover manganese and cobalt resinate; continue the investigation on development of non-glyceryl esters of rosin resin acids for use as surface coating materials; to determine properties uses of limed rosin; and to collect essential statistical data on naval stores requested by the War Production Board and other war agencies.

Improvements and repairs at Naval Stores Station: In the 1943 Appropriation Act there is provided a nonrecurring item of \$3,000 for an improved protection system at the Naval Stores Station, Olustee, Florida. General plans have been drawn up for this work and efforts are being made to determine what equipment is available on the market, what deliveries can be made and the priority ratings required from the War Production Board to procure the necessary materials and equipment. Installation of the additional houses, piping, and an electrical pumping system will be undertaken by the labor upon acquisition of the materials and equipment.

SUPPLEMENTAL FUNDS

There appears in the Department of State section of the Budget a schedule showing estimated obligations for fiscal year 1944 under the heading "Cooperation with American Republics" reflecting a proposed transfer to the Department of Agriculture for intern training of agricultural chemists from South American countries.

Direct Allotments

Project	Obligations: 1942	Estimated obligations: 1943	Estimated obligations: 1944
<u>Special Research Fund (Bureau of Agricultural Chemistry and Engineering):</u> For special agricultural chemical and engineering researches:			
Special research projects	\$106,553	\$94,410	\$94,410
Special research laboratories in major agricultural regions	93,645	5,000	-
Total, Special Research Fund	200,198	99,410	94,410

SUPPLEMENTAL FUNDS -- Contd.

Project	Obligations: 1942	Estimated obligations: 1943	Estimated obligations: 1944
<u>Emergency Rubber Project (Bureau of Agricultural Chemistry and Engineering):</u> For investigations to make available a source of crude rubber:			
Production, harvesting, and mechanical processing machinery investigations (guayule)	--	\$40,734	\$55,000
Production, harvesting, and mechanical processing machinery investigations (goldenrod, Cryptostegia, kok-saghyz, etc.)	--	39,533	50,000
Pilot laboratory investigations on rabbitbrush	\$12,208	8,152	--
Pilot laboratory investigations on guayule	--	71,800	--
Pilot laboratory investigations on Cryptostegia	--	50,000	25,000
Pilot laboratory investigations on kok-saghyz	--	20,000	50,000
Pilot laboratory investigations on goldenrod	--	101,364	100,000
Pilot plant investigations on guayule at Salinas, California	--	15,000	125,000
Total, Emergency Rubber Project	12,208	346,583	405,000
<u>Removal and Reestablishment of Arlington Farm, Virginia (Transfer to Agriculture) (Bureau of Agricultural Chemistry and Engineering):</u> For the removal and reestablishment of functions and activities at Arlington Farm, including plans and specifications, acquisition of land, erection of buildings, equipment, etc., at the Beltsville Research Center	76,259	81,485	--
<u>Emergency Dehydration Investigations (Bureau of Agricultural Chemistry and Engineering):</u> For the improvement of methods of production and distribution of dehydrated foods	54,292	--	--

SUPPLEMENTAL FUNDS - Contd.

Project	Obligations: 1942	Estimated obligations: 1943	Estimated obligations: 1944
Working Fund, Agriculture, Chemistry and Engineering, Advance from Commodity Credit Corporation Capital Fund: For investigations of methods of properly storing and caring for grain on farms	\$14,880	\$15,000	--
Working Fund, Agriculture, Chemistry and Engineering (Emergency Management): For subsistence, travel, and other expenses necessary to provide training for four agricultural chemists from the Republic of Argentina in the Regional Research Laboratories of the Department	4,016	17,260	--
For drawing up working plans for buildings, utilities, and services for a proposed Institute of Tropical Agriculture to be sponsored by the Office of the Coordinator of Inter-American Affairs	25,061	--	--
For project sponsored by the Office of the Coordinator of Inter-American Affairs, to cover cost of transportation and subsistence of Dr. George Jamieson, to Brazil and return, to assist in making a study of the possibilities of the development of the Brazilian vegetable oil industry	700	--	--
For the conduct of experiments on a commercial scale on the use of lint cotton in the manufacture of smokeless powder	796	--	--
Total, Emergency Management	30,573	17,260	--
TOTAL, SUPPLEMENTAL FUNDS (Direct allotments) ..	388,410	559,738	499,

PASSENGER-CARRYING VEHICLES

The Bureau of Agricultural Chemistry and Engineering does not contemplate the purchase of any passenger-carrying vehicles in the fiscal year 1944. It is expected that 20 automobiles will remain in use.

REGIONAL RESEARCH LABORATORIES

The 1944 Budget Estimates provide for a direct appropriation for the four Regional Research Laboratories, authorized by Sections 202(a) to (e), inclusive, of the Agricultural Adjustment Act of 1938, in lieu of an allotment from the appropriation "Conservation and use of agricultural land resources", which appropriation is proposed for reduction by a corresponding amount. (See explanation of change in language.)

Appropriation Act, 1943	\$	--
Proposed transfers in the 1944 estimates:		
From "Conservation and use of agricultural land resources"	+4,000,000	
To other appropriations (see budget schedules for details)	32,605	
Total available, 1943	3,967,395	
Budget estimate, 1944	3,959,385	
Decrease (including a decrease of \$5,390 in travel funds returned to surplus) ...	<u>-8,010</u>	

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase, or decrease
1. Northern regional research laboratory	\$817,101	\$954,050	\$953,395	-655 (1)
2. Southern regional research laboratory	820,658	954,050	953,395	-655 (1)
3. Eastern regional research laboratory	815,649	954,050	953,395	-655 (1)
4. Western regional research laboratory	805,716	954,050	953,395	-655 (1)
5. Central administration ...	120,747	120,910	120,910	--
Covered into Treasury in accordance with Public Law 674	--	5,390	--	-5,390
Allotted to (see budget schedules for details)	10,320	24,895	24,895	--
Unobligated balance	75,004	--	--	--
Total estimate 1944 and comparable amounts 1943 and 1942	3,465,195	3,967,395	3,959,385	-8,010

DECREASE

The decrease of \$8,010 in this item for 1944 consists of \$5,390 decrease in travel funds (returned to surplus in 1943) and:

- (1) A decrease of \$2,620 (\$655 for each Regional Research Laboratory), due a corresponding increase in the amount merged with the appropriation "Salaries and expenses, Office of Solicitor", to put on a full-year basis in 1944 the salaries of a patent attorney and a stenographer rendering legal services in connection with the patent work of the laboratories.

CHANGE IN LANGUAGE

The estimates include proposed new language for this item as follows:

REGIONAL RESEARCH LABORATORIES

For all salaries and expenses, including personal services in the District of Columbia, necessary to enable the Secretary to carry out the provisions of Section 202(a) to 202(e), inclusive of Title II, and subject to the provisions of Section 393 of Title III, of the Agricultural Adjustment Act of 1938 (7 U.S.C. 1292, 1393), including research on food products of farm commodities, \$3,959,385.

The four Regional Research Laboratories authorized by Section 202(a) to 202 inclusive, of Title II of the Agricultural Adjustment Act of 1938 are now established and conducting research. The funds for this work have heretofore been provided by transfer from the appropriation "Conservation and use of agricultural land resources, Department of Agriculture." Since these laboratories are a part of the newly created Agricultural Research Administration it seems desirable to have the language covering the appropriation included under this Administration.

The language proposed includes the same authority and limitations that apply when the item was a part of the appropriation "Conservation and use of agricultural land resources, Department of Agriculture." A corresponding reduction has been made in the estimate for that appropriation.

WORK UNDER THIS APPROPRIATION

Objective: To develop, by research, new scientific, chemical, and technical uses and new and extended markets and outlets for farm commodities, and products and by-products thereof, such as corn; wheat; soybeans; cotton; sweet potatoes; peanuts; apples; vegetables; tobacco; milk products; animal fat and oils; tanning materials, hides, skins, and leather; potatoes; alfalfa; fruits; poultry; and agricultural residues, with special and exclusive emphasis during the war period on the development of replacements or substitutes for critical and strategic materials vital to the conduct of the war.

The Problem and its Significance: A basic problem and need of agriculture under normal peace-time conditions has been to develop new and extended uses and expanded outlets for its products and by-products. The war has emphasized the importance of the program of industrial utilization of farm commodities in certain and many of its more immediate aspects, in order to meet deficiencies in strategic and critical raw materials and to develop substitute replacement materials of great value for both civilian and military needs.

The requirements of war have increased the national consumption of most of the necessities of life and at the same time, the importation of many essential raw materials has been stopped. As the war continues, the list of materials of which the supply is inadequate is growing in length. Replacements and substitutes are necessary for these materials, particularly since the exigencies of our war effort are increasing production in the industries which make use of these raw materials.

Research on the industrial utilization of farm commodities under war conditions must recognize the role which the products of the farm must play in meeting the needs of the Nation and our allies in the present emergency. The adequate production of food, feed, and fiber is the prime requirement of agriculture, but agriculture is ably serving an important dual role in providing many industrial products essential to the war effort. Many low-grade and waste farm materials, as well as food crops, contain appreciable quantities of valuable constituents which may serve for the production of plastics, synthetic rubber, motor fuels and lubricants, building materials, cloth filler and substitutes, fibers, protein meals, films, adhesives, medicines, pharmaceuticals, solvents, hormones and other vital commodities. Methods of making food products available to our armed forces and our allies, from the standpoint of both preservation and shipping space requirements, present a critical problem which must be carried through the research channels for development of suitable methods for producing, preparing, packaging, storing, and delivering frozen foods and of reducing the weight and bulk of foods through dehydration. Both dehydrated and frozen foods have the advantage of not normally requiring the use of metallic packages.

Ample supplies of most farm commodities, together with burdensome surpluses of agricultural residues, constitute a reservoir from which to draw raw materials for such products and processes as are developed, whether during normal times, the present war emergency, or the post-war period.

General Plan: The research work under this appropriation covers the principal agricultural commodities produced in the 48 states. Through chemical, physical, and biological laboratory investigations, it is planned to develop new products or processes involving these commodities, and through chemical engineering research on a pilot plant scale, to establish the commercial feasibility of the given product or process leading to commercial development and use of these farm products.

In view of the imperative war needs, the long-term purpose of stimulating industries by processing agricultural commodities for conversion into profitably produced industrial products has been set aside, while exclusive and

increased emphasis is being placed on the development and improvement, from farm commodities, of products and processes which have immediate significance and application to war needs. Long-term fundamental studies will be prosecuted only to the extent that such information is needed for a specific war use. Short-term problems, the solution of which can contribute to the war program will be emphasized.

Indicated below are the states to be served, together with the commodities to be given initial attention, by each of the laboratories:

Northern Regional Research Laboratory,
Peoria, Illinois

<u>Area</u>	<u>Commodity</u>
Illinois	Agricultural
Indiana	Residues
Iowa	Corn
Kansas	Wheat
Michigan	Soybeans
Minnesota	
Missouri	
Nebraska	
North Dakota	
Ohio	
South Dakota	
Wisconsin	

Southern Regional Research Laboratory,
New Orleans, Louisiana

<u>Area</u>	<u>Commodity</u>
Alabama	Cotton
Arkansas	Sweetpotatoes
Florida	Peanuts
Georgia	
Louisiana	
Mississippi	
Oklahoma	
South Carolina	
Texas	

Eastern Regional Research Laboratory,
Wyndmoor, Pennsylvania

<u>Area</u>	<u>Commodity</u>
Connecticut	Apples
Delaware	Vegetables
Kentucky	Tobacco
Maine	Milk Products
Maryland	Potatoes
Massachusetts	Animal Fats
New Hampshire	and Oils
New Jersey	Tanning Materials,
New York	Hides, Skins,
North Carolina	and Leather
Pennsylvania	
Rhode Island	
Tennessee	
Vermont	
Virginia	
West Virginia	

Western Regional Research Laboratory,
Albany, California

<u>Area</u>	<u>Commodity</u>
Arizona	Apples
California	Alfalfa
Colorado	Fruits
Idaho	Potatoes
Montana	Vegetables
Nevada	Poultry
New Mexico	Wheat
Oregon	
Utah	
Washington	
Wyoming	

It will be noted that research on certain of the commodities has been divided between two laboratories. Such division of effort is based on the importance of the commodity under investigation in the regional areas to which assigned. Careful consideration has been given to the composition of these commodities which suggest different types of utilization and to the coordination of the research activities of the laboratories concerned.

A composite statement of these joint projects is given below. Complete project statements for each laboratory appear on subsequent pages.

	: Northern	: Eastern	: Western	:
	: Laboratory	: Laboratory	: Laboratory	: Total
Wheat utilization investigations:	:	:	:	:
1942 Actual	: \$97,946	: \$ - -	: \$55,798	: \$153,744
1943 Allotment	: 100,000	: - -	: 94,850	: 194,850
1944 Estimate	: 100,000	: - -	: 94,195	: 194,195
Apple utilization investigations:	:	:	:	:
1942 Actual	: - -	: 60,180	: 60,362	: 120,542
1943 Allotment	: - -	: 87,000	: 68,150	: 155,150
1944 Estimate	: - -	: 87,000	: 68,150	: 155,150
Vegetable crop utilization investigations:	:	:	:	:
1942 Actual	: - -	: 24,168	: 132,158	: 156,326
1943 Allotment	: - -	: 34,750	: 242,600	: 277,350
1944 Estimate	: - -	: 34,750	: 242,600	: 277,350
Potato utilization investigations:	:	:	:	:
1942 Actual	: - -	: 92,610	: 37,644	: 130,254
1943 Allotment	: - -	: 120,500	: 31,260	: 151,760
1944 Estimate	: - -	: 119,845	: 31,260	: 151,105

The research program for each laboratory, by commodities, is briefly discussed in the following statements:

NORTHERN REGIONAL RESEARCH LABORATORY

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimate)
1. Construction and equipment of building	\$115,931	\$ 8,000	\$
2. Agricultural residues utilization investigations	213,271	215,000	214,345
3. Corn utilization investigations	389,953	501,050	501,050
4. Wheat utilization investigations (a) ..	97,946	100,000	100,000
5. Soybean utilization investigations	- -	130,000	138,000
Unobligated balance	13,149	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	830,250	954,050	953,395

(a) Joint project with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Construction and equipment of building: With the completion during fiscal year 1943 of a solvent storage vault estimated at \$8,000, this project will be closed. All other phases of building construction and fixed laboratory equipment installation required for full-scale operation of the laboratory at the beginning of fiscal year 1943 have been completed.

Agricultural residues utilization investigations: Each year in the United States there are available 100 to 200 million tons of straw, stalks, hulls, and other crop residues of which little use is made. To realize the commercial utilization, this tremendous reserve of raw material must be substituted for other raw material formerly used in the production of commercial products; or entirely new products must arise from this almost untapped raw material source.

The development of new materials from agricultural residues to supply wartime demands for substitute materials offers many possibilities of which the following are representative of demonstrated accomplishments.

Cellulose pulps for military purposes--at the War Department's request, developments were initiated on special cellulose pulps from agricultural residues for certain confidential military equipment. These pulps were so satisfactory that the War Department requested 100 pounds each of two pulps for test purposes. The pulps are now being tested at a processing plant on pilot plant trials.

Cork substitutes--a substitute for cork is badly needed in the manufacture of seals in crown seal closures which are used for bottling certain foods and most beverages. At the request of manufacturing groups, a product has been developed, composed in part of pith from peanut shells or other agricultural residues, which has been subjected to about thirty practical bottling tests. Certain manufacturers have indicated that in their opinion this product is probably the nearest substitute for cork so far discovered, out of some 800 which have been brought to their attention. The product has been manufactured on a pilot-plant scale, and manufacturing steps appear simple and not to require much critical material. Specifications have been drawn up and about ten thousand discs are in the course of preparation for very complete practical trials. It is estimated that a potential use of 15,000 tons of agricultural residues may result for this purpose, and in addition perhaps 15,000 tons of other agricultural products, such as glue or casein, would be used in the manufacture of the discs.

Plastic replacements--plastic bottle caps have in recent years been substituted for the old-fashioned cork stopper in the capping of all sorts of glass containers used for medicinals, foods, cosmetics, beverages, etc. Because of the shortage of the phenolic pastics formerly used for this purpose, the Northern Regional Research Laboratory was appealed to by members of the bottle making industry and the users of caps to find substitutes. A new plastic molding compound made from lignin from agricultural residues and from 15 to 25 percent phenol-formaldehyde has been developed which appears to have proper characteristics in molding caps and to be capable of being molded at present molding cycles and on present machines. Three commercial trials have been made on this molding powder and the minor difficulties encountered in these trials have been largely corrected, so that the development is on the verge of acceptance by industry.

The short molding cycles and automatic machines used in molding bottle caps are about the most difficult specifications to meet in thermo-setting molding plastics so that it is obvious that a solution of this problem will open up the use of this molding powder to a large number of fields in which military requirements are concerned, and will result in a marked saving of the phenolic components now used for this purpose. It is estimated that the successful solution of this problem may result in a use of approximately 70,000 tons of agricultural residues.

Corn utilization investigations: Research on corn and its products and by-products is of special significance in a time of national emergency. Deficiencies in strategic and critical raw materials such as tin, rubber, starch, and drying oils offer opportunities for the development of replacement materials of great importance both to the civil population and the armed forces. Typical examples are rubber substitutes and extenders from cornstarch and corn oil; plastic containers from the protein of corn for processing of foods; new types of starch and drying oils, to supplement the dwindling supplies of these materials available from foreign sources; motor fuels to supplement our supplies of gasoline; replacements for imported adhesives; vital war chemicals; and a new therapeutic agent for war wounds.

These are all fields in which work is now in progress. For these purposes and for use in meeting the greatly increased feed requirements occasioned by a greatly expanded livestock industry, there is available a corn crop bumper proportions and a crop carry-over of approximately one-half billion bushels.

The few subjects discussed briefly in this statement were selected as representative of the relationship to the war effort of all the work being carried out on corn.

Synthetic rubber--the Laboratory has developed two processes for the production of butylene glycol by the fermentation of corn. This glycerine-like material can be converted to butadiene, the basic intermediate for synthetic rubber production. A companion process for the manufacture of butadiene from butylene glycol has also been developed. Three industrial conferences with respective attendances of 35, 33, and 62 have been held to discuss the Laboratory's research developments on this project, and a fourth conference was held at the request of the Rubber Coordinator to consider pilot plant operations now in progress.

Early in August the Baruch Committee reviewed the laboratory and semi-plant scale work being conducted at the Northern Regional Research Laboratory on the production and recovery of butylene glycol and its conversion to butadiene. This process was deemed sufficiently promising for the Committee to recommend the construction in 1943 of a 27,000 ton plant, which is the butylene glycol process, provided that it has been proved by that time to be better than the processes starting with alcohol. The Committee directed that pilot plant studies be carried out. Pilot plant equipment has now been installed for the complete study of the process and the work is actively under way.

Rubber substitute--"Norepol", an elastic, vulcanizable polymer, referred to in detail under soybeans (project No. 5) can also be made from corn oil.

Butylene glycol--this material is of interest not only because of its use in the manufacture of synthetic rubber, but also because it possesses unique properties which are creating great interest on the part of both industry and the armed services in its potential use as an anti-freeze, power transmission fluid, and glycerine substitute. There is little doubt that butylene glycol will form the basis of a post-war industry.

Penicillin--a antiseptic, penicillin, formed by the growth of a mold, Penicillium notatum, on corn sugar solutions is now undergoing extensive clinical tests for the treatment of wounds and burns. It can be applied to the surface or taken intravenously or orally without toxic effects, and is particularly efficacious against infections caused by staphylococci. Although penicillin was discovered elsewhere, the development work which the Northern Regional Research Laboratory was requested by the Committee on Medical Research of the National Defense Research Council to undertake this product has resulted in a 75-fold increase in the yield of this material with promise of still higher yields. This has made it possible to

produce penicillin on a scale large enough to support the necessary clinical testing, and pharmaceutical concerns are now producing the material for this purpose.

Zein--zein is an important protein which has film-forming, plastic, and adhesive properties. Approximately two pounds of zein are present in every bushel of processed corn. The present industrial process for recovering zein is inherently expensive and difficult to operate. An improved process has been developed by the Laboratory, and methods have also been perfected for stabilizing zein which will materially lower the cost of production and expand the industrial usefulness of this important protein. Zein is now being considered for confidential military uses.

Ethyl alcohol--erection, installation, and testing of equipment for the alcohol pilot plant have now been completed. This experimental plant has a capacity of 500 gallons of anhydrous ethyl alcohol per 24-hour day under continuous operation, and it has been designed for flexibility so that it may be used on all types of grains and other agricultural commodities to produce many products. Operation of this alcohol pilot plant will definitely answer many questions as to the practicability, cost, and advantages of proposed procedures for obtaining alcohol and other industrial chemicals as raw materials from agricultural commodities for the production of synthetic rubber, as solvents for munitions manufacture, as well as for motor fuel. The plant is now being used in the production of butylene glycol.

At the request of one of the other agencies of the Government, a thorough survey of the potential alcohol production according to types and locations in the United States was made by personnel of the Northern Regional Research Laboratory. This survey was supplemented by extensive reports covering new plant erections, metal requirements, and cost, including cost of processing in different-sized plants. The most recent figures for the possible use of ethyl alcohol in the manufacture of explosives, in the production of synthetic rubber, and in miscellaneous chemical uses, are based originally on the figures compiled in this survey.

Wheat utilization investigations: Wheat, since the dawn of history, has been an essential commodity in the conduct of warfare, serving as the chief item in the diet of the fighting man. Today, due in part to modern advances in food preservation, wheat does not have the importance as a foodstuff which has been accorded it in the past. It is, however, in keeping with the technological nature of modern warfare, destined to play no less an important part in the industrial machine which is the basic structure beneath the whole war effort.

Currently, the supply of wheat in the United States amounts to 1,617 million bushels. This huge amount of grain, equal to two and one-half years' normal domestic requirements, has created a critical storage problem. Fortunately, there are ways in which this huge surplus can be turned to good account. However, because wheat has so seldom been diverted into industrial channels in the past, there is a decided deficiency in the technological knowledge

necessary for its successful utilization. Work now being conducted is designed to clear the way for the successful introduction of wheat as a raw material in industry for use in the war effort.

The examples given below have been selected as representative of contribution to the war effort made possible by research on the industrial utilization of wheat.

Alcohol--tests made at the Northern Regional Research Laboratory have confirmed previous knowledge that wheat can be used as an alternative for corn in the production of alcohol. Due to the large surplus of wheat, the Commodity Credit Corporation has urged the use of as much wheat as possible in the current alcohol production program. This suggested procedure has given rise to many complaints from the alcohol producers relative to the difficulties encountered in the fermenting of wheat, the lower yields of alcohol obtained, and the resulting reduced plant capacity. At the request of the War Production Board, therefore, a conference was called at the Northern Regional Research Laboratory, at which 43 representatives of 26 organizations drew up a short-time program of research directed toward the evaluation or solution of the problems encountered. The Northern Regional Research Laboratory is supervising and coordinating this research program with the cooperation of universities and industry. The War Production Board will report the results to all alcohol producers.

Wheat starch--a new method for the production of wheat starch from the whole wheat grain has been developed in the Northern Regional Research Laboratory which is superior to the one now used commercially in which flour is the starting material. This method can be accomplished in practically the same type of equipment now used in the wet milling of corn. One large starch producer has already begun the processing of wheat by the new method, and another group from the Northwest is interested in producing syrups and sugars from starch to be obtained from surplus wheat by this process.

Synthetic rubber--wheat as a carbohydrate source can be used as an alternative with corn in the production of butylene glycol, referred to under project 3. This has been confirmed by pilot plant runs made on wheat in the Northern Regional Research Laboratory.

Soybean utilization investigations:* Soybean oil, soybean meal, and other soybean products are filling both military and civilian needs for a wide variety of essential items which were formerly derived from imported sources.

* These investigations were formerly conducted, primarily under the Special Research Fund, at the U. S. Regional Soybean Industrial Products Laboratory at Urbana, Illinois. In accordance with the 1943 Appropriation Act, the industrial utilization phases of soybean investigations were transferred and absorbed by the Northern Regional Research Laboratory at Peoria, Illinois, effective July 1, 1942. Examples of progress for the fiscal year 1942 are included under the Special Research Fund.

materials, or which have previously been derived from other domestic sources which are inadequate to meet emergency requirements. Fats and oils, as an example, are in ever-increasing demand to feed our war machine, and supplies have been seriously curtailed through loss of imports. To meet the threat of a fat and oil shortage, American farmers this year broke all records for soybean production, harvesting 210 million bushels. This is almost twice the previous record and makes the United States the world's foremost producer of soybeans. Approximately 180 million bushels should be available for crushing, to yield over one and one-half billion pounds of oil for industrial, lard-lease, and food uses. Over four million tons of soybean meal will be available for livestock feed to maintain our war production of meat at present record levels. Soybean meal also affords an excellent raw material for industry.

Soybean oil is a utility oil and is widely used in the food, soap, protective coatings, and miscellaneous industries. Currently, about 85 percent is used for edible purposes. We are largely dependent upon foreign sources for our strategic drying oils such as tung, perilla, linseed, castor, rape, and oiticica. To meet the critical shortage of these specialty oils, it is urgent that means be developed for producing adequate supplies from soybeans and other domestically produced materials by technological processing and modification.

Soybean meal offers an abundant and available supply of protein similar to casein in many properties. With improvement in processing methods and increase in processing capacity, adequate supplies may be made available to meet shortages in casein used for a variety of adhesive purposes, for plastics, and textile fibers. Soybean meal and soybean protein have potentially increased utility as an adhesive in paper coatings and sizes, glue, water paint, insecticidal sprays, and miscellaneous products. Soybean meal can replace a certain amount of phenol, a strategic material widely used in the manufacture of plastics. Purified soybean protein has definite possibilities for relieving critical shortages of silk and wool, and is now being used for casein for this purpose.

The development of war uses for soybean oil, meal, and protein is the subject of intensified research. The following items selected from the war activity projects of the Laboratory are cited as typical examples of major accomplishments in this field:

Rubber substitute--"Norepol", an elastic, vulcanizable polymer, has been developed at this Laboratory by fractionating and chemically modifying both soybean and corn oils. This rubber-like material, which has been mentioned in the Baruch Committee Report, was announced to 47 representatives of industry at an industrial conference in this Laboratory on July 13, 1942, and was further discussed at a second conference on November 12, 1942, in which about 100 representatives took part.

Norepol is already being widely exploited by industry. One organization has recently announced present commercial production of 250,000 pounds a month

under the trade name of "Agripol." Another manufacturer has likewise reported a production of 250,000 pounds a month under the name of "Vulprene." One producer, which has made about 100,000 pounds of the Norepol polyester to date in commercial batches, has reported a capacity of 80,000 pounds per month in existing equipment. Still another company has announced that it can consume 500,000 pounds of Norepol polyester per month for immediate use as a rubber latex substitute. Many other industries are actively engaged in the evaluation of Norepol for their special needs.

Norepol is already contributing a definite service to the country as a replacement for rubber and reclaim in many essential war uses, and it has been estimated that the material which can be manufactured largely with existing equipment may amount to as much as 100,000,000 pounds a year. This would mean a total utilization of approximately 200,000,000 pounds of soybean oil or corn oil annually.

SOUTHERN REGIONAL RESEARCH LABORATORY

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):
1. Construction and equipment of building	\$88,719	\$ --	\$ --
2. Cotton utilization investigations	586,799	763,140	762,61
3. Sweetpotato utilization investigations	102,548	133,626	133,5
4. Peanut utilization investigations	42,592	57,284	57,2
Unobligated balance	9,592	--	--
Total estimate 1944 and comparable amounts 1943 and 1942	830,250	954,050	953,3

Examples of Progress and Current Program:

Construction and equipment of building: This project was terminated with the close of fiscal year 1942. All phases of building construction and fixed laboratory equipment installation required for full-scale operation of the laboratory at the beginning of fiscal year 1943 have been completed.

Cotton utilization investigations: At the beginning of the fiscal year 1942, the major part of the research on cotton and cottonseed products was on problems relating to National Defense. Shortly after December 7, 1941, the research program on cotton and cottonseed products was converted 100% to problems directly connected with the Nation's war effort. Close contact has been maintained with the War Department, the War

Production Board, Office of Civilian Defense, Office of Agricultural War Relations, and other war agencies, for the purpose of selecting projects which will be of maximum usefulness in the war effort. Close contact has also been maintained with various industries for the same purpose. Projects which would probably require several years to yield useful results have been deferred until the end of the war. Short-time special projects of a war effort nature are being given precedence over all others. For the most part, the research projects on cotton and cottonseed products deal with the development of products to replace or supplement products made from imported or scarce domestic commodities.

Utilization of lint cotton in the manufacture of smokeless power - Research on this project was begun during the fiscal year 1941 because of possible shortage of chemical grade linters which are used in large quantities for this purpose. In cooperation with the Hercules Powder Company and the Naval Powder Factory, several tons of lint cotton were cut, purified, and manufactured into smokeless powder, and the resulting powder found satisfactory in every respect. Available commercial cutting machines used in these tests did not have as high a capacity as is required, so a small-scale machine especially for cutting lint cotton was designed and built. This cutter, with associated feeding equipment, gave highly satisfactory results, and both the War Department and the War Production Board immediately requested the development of a full-size machine of this type at the earliest possible date. Detailed construction plans have been completed and the construction will be carried out as a separate project by the Agricultural Engineering Division of the Bureau of Agricultural Chemistry and Engineering.

Preservation of sandbag, camouflage, and other military fabrics - Research on the selection and development of preservative treatments for fabrics of this type and on accelerated tests for same has been continued. One phase of this research has been completed and the results furnished the Corps of Engineers, United States Army (the agency requesting this work) which is now using the information as the basis of their purchase specifications for sandbags. Current research includes the development of new and more effective treatments, and the development and evaluation of better test methods for determining effective treatments. Following a recent request from the Jeffersonville Quartermaster Depot, this type of research is being considerably expanded.

Tire cord--the Army needs and wants the best possible pneumatic tires for war use. Official statements have recently been made to the effect that combat tires and tires of the larger sizes made from rayon cord are superior to similar tires made from cotton cord. The Laboratory is conducting intensive research to determine the underlying physical and chemical reasons for this reported difference in performance. On the basis of results obtained from this research an attempt will be made to develop an improved type of cotton tire cord which will give better performance. Successful completion of this project should make it possible for the Army to secure the best possible tires made from cord which can be manufactured in existing cotton tire cord plants, and thereby overcome the necessity for allocating strategic metals

for the manufacture of additional equipment which is necessary for the expanded production of rayon tire cord. Information has been obtained from Army, the War Production Board, large and small tire manufacturers, a large independent cotton tire cord manufacturer, and a large transcontinental trucking firm.

Rubberless cotton fire hose--present fire hose is of two principal types: (1) Cotton fabric, rubber-lined, and (2) Unlined linen, both of which involve the use of highly critical materials. Research on this project was undertaken at the request of the Office of Civilian Defense and is concentrated mainly on the development of a chemically treated cotton yarn, which will swell and prevent leakage when made into an unlined hose. One type of experimentally developed yarn has been hand-woven into a fabric which compares favorably with better types of linen fire hose. Arrangements are now being made to weave some of this special yarn into hose on commercial equipment for further tests. Research is also being conducted with various plastic compounds as a substitute for rubber in lined hose.

Cotton binder twine--binder twine for harvesting small grain and other crops is an essential item in obtaining the Nation's food supply. A definite shortage of sisal and henequen for making binder twine is anticipated for 1943. Research is in progress on the development of binder twine made from cotton and from cotton mixed with other fibers. One experimental lot of cotton binder twine has already been given field tests, but a tabulation and analysis of the results has not yet been received. Laboratory tests are being made on samples of experimental binder twine made by private firms and submitted to the Laboratory by the War Production Board. The War Production Board has requested that the Laboratory's research on binder twine be intensified.

Cotton and plastic hose adapter--research was begun on this project at the request of the Office of Civilian Defense, to design and develop a rubberless hose adapter for connecting ordinary garden hose to unthreaded faucets in kitchens and bathrooms for emergency use in fighting fires started by incendiary bombs. Several physically satisfactory hose adapters have been made by employing a plastic liner between 2 layers of braided cotton tubing. Research is now being directed toward the development of a practical commercial process for making these adapters.

Cotton bags and bagging--enemy activity in the Far East has greatly reduced our supplies of burlap and has made future supplies highly uncertain. Normally, about half of the bags for packaging agricultural commodities are made from burlap. War-time requirements for cotton bag fabrics by width, weight, and construction, have been determined and this information furnished the Office for Agricultural War Relations and the War Production Board. The statistical and technical information secured and compiled under this project has provided the basis of action taken by the War Production Board to insure adequate supplies of cotton bag fabrics. It is estimated that about eight million patterns of cotton fabrics for baling cotton will be required to handle the 1943 crop, as compared to approximately two million cotton pat-

required for the 1942 crop. Several different types of cotton bagging are being developed so that maximum production can be obtained from available facilities in the cotton textile industry.

Other war research projects--other war research projects include work on resin-finished fabrics to replace rubberized fabrics; nonshatterable window glass materials made from cotton combined with plastics; the development of a satisfactory cotton tent rope; the use of lint cotton in the manufacture of viscose, cellulose acetate, and other cellulose derivatives; and the development of plasticizers for cellulose acetate to replace the usual plasticizers of which there is a critical shortage.

Cottonseed investigations--a substitute for imported palm oil used in the manufacture of tin plate and cold rolling of steel was developed from cottonseed oil by controlled hydrogenation. Specifications for the commercial production of this substitute oil were prepared and made available to the oil processing and tin plate industries.

Several modified oils intended for use in the textile industry to replace imported olive oil are being developed. A few have been submitted to commercial sulfonators for test. These oils were prepared from domestic cottonseed oil by a combination of controlled hydrogenation and solvent winterization by a newly devised process.

An improved process for the production of salad oil by solvent winterization of cottonseed oil has been developed. Solvent winterization requires only five to six hours to produce a salad oil compared to four to six days by the present commercial method. This oil has a superior cold test, pour point, and keeping quality as compared with the ordinary commercially winterized cottonseed oil.

Work on the utilization of cottonseed meal and proteins is being directed toward the use of commercial press meals in the production of glues and adhesives for use in the manufacture of plywood, especially from southern hardwoods. Adhesives of reasonably good glue strength can be made from commercial cottonseed meals, but other characteristics, particularly color, renders them inapplicable for the production of thin, light-colored, furniture veneers. No doubt all of the properties of these adhesives can and will be improved by further work.

Several methods of improving the storage properties of cottonseed have been developed on a laboratory scale and pilot plant tests are in progress after which the seed will be processed to determine the quality of oil and meal which can be produced from the stored seed. Excessively wet seed which normally could not be stored under existing conditions has been successfully stored on a pilot plant scale for a period of approximately three months without any evidence of breakdown of the oil. In wet years when harvested cottonseed is high in moisture, a commercially feasible preservative could increase supplies of edible oils by substantial quantities.

Sweetpotato utilization investigations: Intensive laboratory and pilot plant investigations have been prosecuted on the production and utilization of sweetpotato starch and other sweetpotato products and by-products. The program has been greatly facilitated by installation of pilot plant equipment comprising all essential units for modern starch manufacture and with a capacity of 1,000 pounds of sweetpotatoes per hour. Even before entry of the United States into the war, efforts were largely concentrated on the manufacture of sweetpotato starch, to improve the yield, quality, and uniformity of the product; to furnish technical advice and assistance to the Laurel Starch Plant, the only existing source of sweetpotato starch in the United States and to render similar assistance to other enterprises undertaking the production of this commodity.

With the outbreak of war in the Pacific and the consequent abrupt curtailment of imports of tropical root starches, all effort was concentrated on a similar war activity, "Sweetpotato Starch to Supplement Supplies of Imported Root Starches."

On an average annual importation of some 350,000,000 pounds of such starch, mainly tapioca, around 100,000,000 or more pounds have entered industrial uses in which they are irreplaceable except by root starch of similar properties. Such uses are the production of re-moistening gums for postage and revenue stamps, envelopes, and gummed paper; the manufacture of plywood and other laminated materials; specialized applications in the textile trade; and other specialized uses. Sweetpotato starch is a satisfactory substitute for tapioca in practically all of these specialized uses. All possible technical assistance has been given the Laurel Starch Plant in maximum production of sweetpotato starch best adapted in quality to replacement or supplement of tapioca in essential uses. Improved equipment for uniform blending of starch in carlot quantities was designed and placed in operation together with a system for accurate control. As a result, the economy and efficiency of operation of the plant, and the quality and uniformity of the product were materially improved; and a serious dust-explosion hazard was eliminated. With further assistance in processing operations, the plant turned out the highest yield of starch per bushel of sweetpotatoes in its history, with quality predominantly superior to that of previous production.

Laboratory and pilot plant investigations are in progress to provide additional information needed to insure immediately successful operation of the Laurel process when carried over to larger scale operations in new plants, output from which will offset the shortage of root starches for specialized indispensable uses. A systematic investigation of the extraction of carotene from yellow varieties of sweetpotatoes affords a basis for appraising the feasibility of use of all sweetpotatoes as a commercial source of carotene.

Peanut utilization investigations: Peanut oil has been modified by means of hydrogenation, ester interchange, and solvent winterization to produce substitute oils to replace imported olive oil used in the textile and other industries. Samples of these oils have been submitted to industrial sulfonators for sulfonation and testing as textile oils. Although the n

oils were formulated with the thought of duplicating the properties of olive oil, it was found they possessed desirable properties which make them superior to those of any natural olive oil, for certain uses.

Synthetic waxes are being prepared from the solid fatty acid fraction of peanut oil with a view to replacing imported Japan, Candelilla, and Carnauba waxes in various industrial applications. A number of these waxes have been submitted to manufacturers for examination. Reports received to date indicate some of these waxes are suitable as replacements for those normally imported and now in scarcity.

Because of the considerable concern regarding possible loss of oil during milling of peanuts (so-called invisible oil loss), and the consequent agitation to penalize growers for this processing loss, arrangements were made to carry out a rigidly controlled mill test during which 330 tons of peanuts were processed for oil and meal. The test was carried out in a modern peanut mill of one of the largest and most progressive industrial processors of oils and oilseeds. An oil balance, as well as an overall materials balance of all products entering and leaving the mill, indicated an oil loss of less than 0.2 per cent.

Extensive investigations are being carried out on peanut meal especially with respect to means of isolating and purifying peanut proteins for use in the production of adhesives, sizes, paper coatings, and synthetic wool-like fibers. Means have been devised for carrying out these operations and especially for removing or controlling the natural pigments of peanut meal which have a marked effect on paper coatings and fibers.

A twenty-ton and four five-ton storage silos have been built to handle adequate quantities of peanuts (and cottonseed). Hullers and separating equipment which were obtained on loan are being installed to prepare and clean peanuts (and cottonseed) for large-scale experiments. The pilot plant includes a half size expeller; a small complete flaking, cooking, and hydraulic pressing unit; and an eight cell diffusion battery solvent extraction system with all auxiliaries for separation of oil by various methods. A complete continuous refining system has been designed, the centrifugal has been purchased, and the various parts are being built. An ejector has been purchased and will be used in operating a vacuum oil drier and deodorizer which has been constructed. Designs have been completed and the main units constructed for carrying out hydrogenation of oil in large batches.

EASTERN REGIONAL RESEARCH LABORATORY

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimate)
1. Construction and equipment of building .	\$156,244	\$ - -	\$ - -
2. Apple utilization investigations (a) ...	60,180	87,000	87,000
3. Vegetable utilization investigations (a) :	24,168	34,750	34,750
4. Tobacco utilization investigations	118,658	183,000	183,000
5. Milk products utilization investigations :	187,125	257,400	257,400
6. Animal fats and oils utilization inves- tigations	128,496	202,400	202,400
7. Potato utilization investigations (a) ...:	92,610	120,500	119,848
8. Tanning materials, hides, skins, and leather utilization investigations ... :	48,168	69,000	69,000
Unobligated balance	14,601	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	830,250	954,050	953,398

(a) Joint projects with Western Regional Research Laboratory.

Examples of Progress and Current Program:

Construction and equipment of building: This project was terminated at the close of fiscal year 1942. All phases of building construction and fix laboratory equipment installation required for full-scale operation of the laboratory at the beginning of fiscal year 1943 have been completed.

Apple utilization investigations: During the year emphasis was shifted and placed entirely on those phases of the research program which deal with developments of products essential or useful to the war effort.

Apple sirup--originally an extensive study on the preparation of an apple juice concentrate retaining all of the flavor and color of the original juice had been undertaken. With signs of approaching war, however, the original purpose was modified, and effort was focused on the development of a process for the preparation of an apple sirup from which all possible color, flavor and acidity have been removed, the product to serve as a sugar supplement for other possible uses. Study of the factors involved resulted in the development of a simple method for manufacturing a bland, very sweet, high levulose sirup suitable for many purposes. The character of the product is such that it can be substituted in part for glycerine in the tobacco industry and there is a known demand of 3,000,000 pounds for this purpose. Bakery and confectionery products and table sirups are other possible outlets.

Complete information regarding the process and product has been made available to about 300 interested individuals and organizations. Commercial manufacture is going forward, impeded somewhat by difficulties in obtaining certain equipment.

Modified pectin--in cooperation with the Delaware Agricultural Experiment Station, increased attention was likewise placed on methods for the preparation and manufacture from apple pectin of a low methyl ester pectinic acid which forms a stable calcium gel. With this pectinate fruit jellies and jams can be made with any desired amount of sugar rather than the required 65 percent sugar with ordinary pectin. It is thus a sugar or fruit conserving product. Other applications of this product are for use with frozen fruit to prevent loss of juice on thawing, as a substitute for gums in pharmaceutical preparations, and for treatment of wounds. Low methyl ester pectin was prepared both by acid and enzyme treatment and the resulting products compared. Although the technique of preparing the enzyme demethylated product is much simpler, the acid method yields a product with superior properties for use in fruit jams and jellies. Pilot plant scale work is now in progress to develop a commercially feasible process for manufacturing the low-sugar jellying pectin from apple pomace.

Vegetable utilization investigations: Because the war has created a demand for larger quantities of vitamin concentrates and at the same time the supply of fish liver oils, the main source of vitamin A, is now severely reduced, attention during the year was focused on development of methods for the recovery of these essential dietary substances from waste vegetable materials that accumulate in large quantities at vegetable processing factories. Preliminary to efforts on the recovery of these materials was the assembly and analysis of samples from about 40 different vegetables.

Carotene (Pro-vitamin A)--the carotene values for the samples of vegetable tissues analyzed varied from 0 to 417 micrograms per gram. Some leafy materials, notably broccoli, beets, and lima beans, show such high carotene content and occur in such large quantities in small areas that they indicate real promise as commercial sources of carotene. Large scale work on the extraction and recovery of carotene is now in progress.

Riboflavin--the leafy portions of the vegetable tissues examined likewise contain the larger proportion of riboflavin. The values are low, ranging from 5 to 25 micrograms per gram. Some of the tissues, however, compared favorably with dried skim milk, a commercial source of the vitamin for poultry feeds.

Tobacco utilization investigations: Nicotine is the most important by-product obtained from tobacco. It is used in the preparation of insecticides and for the manufacture of nicotinic acid (pellagra-preventive vitamin). Because the war has cut off certain insecticides formerly imported and because of the increased importance of crop protection against insect pests, it is important that every effort be made to improve and extend the use of nicotine in insecticides. A tremendous increase in the quantity of nicotinic acid

required for fortification of foods also has increased the importance of this substance.

Nicotine insecticides—Nicotine is our most versatile insecticide. It is a contact poison, a fumigant, and a stomach poison. Although research is underway to improve nicotine preparations for all three purposes, special importance is now attached to the possibility of nicotine as a contact poison to replace shortages of imported pyrethrum and rotenone materials. Various forms of hard and soft rubber may be impregnated with nicotine. The alkaloid will then vaporize slowly, the rate depending on size of rubber particles and on temperature. A Hard rubber dust containing about 37 percent sulfur and 2 percent nicotine will lose about 2 percent vapor during the first two days so and the remaining 3 percent will be fixed. Ground soft rubber containing 2 percent or 3 percent sulfur and impregnated with nicotine will vaporize the chemical at room temperature rather uniformly over a period of several weeks. About 30 pounds of various combinations of rubber and nicotine, and rubber, nicotine, and oil, have been sent out for field tests on pea aphids, peach borer, and mushroom insects. Forms of natural rubber are more suitable as carriers for nicotine than the synthetic plastics as the alkaloid is rather readily washed out of the latter. Attempts to prepare nicotine-dye compounds suitable for staining wood pulp for use as an insecticide dust have been partially successful. Samples have been prepared carrying from 1.8 percent to 7.4 percent nicotine. Several copper-nicotine-dye salts have also been prepared. They are crystalline solids of varying solubility in organic solvents. Insecticidal dusts containing small amounts of nicotine and derris powder mixed with pyrophyllite have been prepared. Preliminary results indicate the nicotine-derris dust mixtures are effective aphidicides. About 40 new compounds have been prepared in which nicotine combined with an acid to form a double salt. The nicotine-dye combinations and the nicotine double salts are entirely new series of compounds. Their insecticidal and fungicidal properties are now being tested with some preliminary evidence that a number may have real value. This may be a means of meeting the acute shortage of insecticides and fungicides due to the war.

Anti-pellagra vitamin (nicotinic acid)—vitamin fortification of wheat flour which during the past year has been widely adopted by the milling industry created a sudden demand for about 200,000 pounds of nicotinic acid whereas in 1940 only about 10,000 pounds of this compound were made. In view of the present meat shortage additional large quantities of nicotinic acid should be available to replace this loss in the diet. Intensive study was made during the year looking to the development of new methods for the oxidation of nicotinic acid which did not require the use of critical chemical agents. Catalytic liquid phase oxidation under optimum conditions gave approximately 50 percent yields of nicotinic acid. The catalytic vapor phase oxidation was also studied. The best yields to date have been slightly less than 50 percent and vigorous efforts are under way looking to perfection of this method.

Milk products utilization investigations: Because of the war and the resulting demand for increased quantities of critical war materials, research

on milk products is being conducted along lines which should yield immediately practicable results in (1) improving the characteristics of protein plastics to make possible their substitution for other plastics and metals required for vital war needs, (2) development of artificial protein fibers suitable as wool replacement materials, (3) recovery and utilization of whey proteins and recovery of casein from skim milk on farms, and (4) the production from lactic acid (derived by fermentation from whey) of acrylate resins and of important compounds for use as plasticizers and in the manufacture of certain synthetic rubbers.

Plastics from proteins--much of the work essential to the procurement of proper equipment for the compounding, molding, and testing of protein plastics has been completed, and the groundwork has been laid for further intensive investigations. The plastic flow and water absorption properties of all the molding powders examined indicate much room for improvement. Protein plastics are of importance in war time because they can serve as replacements for critical metals and for pastics such as phenol- and urea-formaldehyde resins which themselves are largely composed of critical materials. To date only comparatively small articles can be made entirely from protein plastic, due to the difficulties in regard to both water absorption and hardening with formaldehyde of larger objects. If these difficulties can be solved, the use of protein plastics might be extended to larger pieces.

Wool substitutes from proteins--at this time it is particularly important to develop all satisfactory substitutes for wool. Artificially extruded protein fiber is one substitute which holds great promise. A simple laboratory spinning unit has been designed and constructed, and considerable experimental work carried out. The dry tensile strength of the product produced in this work has been increased to an appreciable extent. Further definite increase in both wet and dry tensile strength is needed in order to make the fiber less dependent upon blending with superior fibers for textile use. Although present indications are that protein fiber, because of its heat insulating properties, will have chief war time use as a wool substitute, it is possible that a large increase in tensile strength might result in its use as a silk substitute.

Recovery of casein from skim milk on farms and recovery and utilization of whey proteins - The proteins of whey have been separated by precipitating with the classical protein precipitants such as metaphosphoric and tannic acids as well as with a series of new sulfuric acid esters and sulfonates or organic compounds. Over 30 substances of the latter types have been tested, and preliminary studies have been made on the properties of the recovered protein complexes. A wooden apparatus for the preparation of casein from skim milk on the farm has been designed and constructed and used in experimental work for recovery of the casein. The equipment is simple and constructed of materials easily obtainable. Several batches of casein prepared by use of this equipment were found to be lighter in color than any of the commercial acid caseins, and equal to the best of the commercial samples. This equipment would appear to be suitable for recovery of casein from skim milk on farms.

Synthetic resins, plasticizers, and synthetic rubbers from milk sugar - Studies have been carried out on the preparation of synthetic rubber intermediates and rubber compounding materials such as methyl acrylate, acrylonitrile, and other lactic acid derivatives. Satisfactory methods for converting lactic acid (prepared from lactose in whey by fermentation) into methyl acrylate have been developed. It has been demonstrated in commercial practice that methyl acrylate can be co-polymerized with butadiene to produce a synthetic rubber which is easily handled on the present rubber equipment. The vulcanized material has certain inherent characteristics which are as good or better than those of natural rubber. Considerable progress was made in attempts to develop a method for converting lactic acid into acrylonitrile, one of the two components used in the manufacture of Buna types of synthetic rubber. The first two steps of the proposed three-step process have been worked out satisfactorily and the third step is under investigation. Acrylonitrile can be co-polymerized with butadiene, methyl acrylate, vinyl acetate or other unsaturated materials to make a synthetic rubber which is unusually tough and oil resistant. Large quantities of acrylonitrile are now used for the manufacture of synthetic rubber and plastic materials.

Animal fats and oils utilization investigations: The original research program has been modified because of the war to emphasize fully the following: (1) Production of materials useful in the manufacture of plastics, dielectrics, free-lathering soaps and lubricants from animal fats, (2) improved recovery of glycerine from animal fats and oils, and (3) development of methods for the prevention of rancidity in lard and food products containing animal fats.

Plastics, dielectrics, and free-lathering soaps and lubricants from animal fats - Lard oil has been air blown at elevated temperatures in an attempt to prepare an oxidized oil with some of the properties of castor oil. The blown lard oil was found to approximate certain properties of castor oil, and in one important respect (viscosity index) to be superior to castor oil. Castor oil finds considerable utility as a plasticizer in the manufacture of artificial leather and as an addition agent to lubricants. Blown lard oil will be tested as a substitute or partial substitute for castor oil in the uses mentioned.

Glycerine from animal fats--in view of the critical importance of glycerine in the war effort and of the prime need for its maximum recovery from inedible and waste fats, studies were made to develop an improved fat-splitting reagent. Out of a series of synthetic catalysts, sulfoxylstearic acid, even though more expensive, was found to have distinct advantages over present commercial agents used for this purpose. For example, the yield of glycerine in present commercial acid fat splitting is about 85% obtained in from 24 to 48 hours, whereas with the synthetic catalyst yields in excess of 94 percent are obtained in 24 hours. Moreover, the quality of the products, glycerine and fatty acids, is much improved.

Preservation of lard and foods containing animal fats--intensive effort has been devoted to studies on the improved stability or keeping quality of lard

Two new series of synthetic fat soluble antioxidants have been prepared and their antioxidant properties tested by accelerated aging methods. The new fat soluble antioxidant compounds are derived from d-isoascorbic acid and l-ascorbic acid (vitamin C) by esterification with suitable fatty acids which renders the ascorbic acids fat soluble without destroying their antioxidant properties, and in the case of l-ascorbic acid without impairing its anti-scorbutic value. Under the test conditions (100°C) both the d-isoascorbyl and l-ascorbyl esters are effective as antioxidants for lard as well as all other fats and oils tested. Further work will be necessary to evaluate these compounds under normal storage conditions and at elevated temperatures such as are used in deep-fat frying or baking.

Potato utilization investigations: Because of the war research has been concentrated largely on (1) preparation of adhesives from potato starch to replace adhesives formerly made from imported tapioca starch, and (2) preparation of potato starch derivatives to be used in formulation of protective coatings, lacquers, and plastics for which there is a greatly increased demand to meet war needs.

Adhesives from potato starch---the effects of temperature, amount of moisture in the starch, amount of catalyst used, and other variables involved in the dextrinization of potato starch have been studied. Results indicate that dextrans can be made ranging from low solubility, high viscosity, and quick set, to high solubility, low viscosity, and no gelling. With adequate supplies of cull and low grade potatoes for starch manufacture, commercialization of this dextrin would make this country independent of dextrans from imported tapioca starch. Reports of tests made by commercial users of adhesive dextrans indicate that dextrin made from white potato starch can be used with entire satisfaction to replace dextrin formerly made from imported cassava starch.

Plastics---coatings, sizes, and lacquers from potato starch - Primary and secondary starch esters which are soluble in organic solvents have been prepared. Solutions of the starch acetate and aceto-butyrate have been formulated, films have been cast, and coatings have been applied to metals and fibrous materials. Replacement of cellulose esters and other plastic materials by starch derivatives would alleviate the shortage of synthetic resins now used for adhesives, coatings, sizes, and lacquers.

Tanning materials, hides, skins, and leather utilization investigations: Because of the increased demand for leather resulting from war needs, and the cutting off of a considerable part of our importation of tannin materials, research has been directed chiefly to (1) tannin from Western hemlock bark, (2) development of domestic vegetable tanning materials, and (3) conservation of chrome supplies by the development of new tannages and improvement of leather for Army and Navy use.

Tannin from Western hemlock bark---tanning materials from vegetable sources are indispensable in the production of leather and for this reason they are classed as military critical materials. The Armed Forces must be supplied with vast quantities of leather in the form of shoes, soles, garments,

belting, harness, bags, straps, cases, mechanical leathers, and other leather articles. All civilians, particularly those engaged in the production of war materials, must likewise be adequately supplied with numerous leather articles.

Our estimated requirements of 100 percent tannin for 1942 amount to 298 million pounds. In 1941 the United States imported and produced domestically a total of 288 million pounds of which approximately 188 million pounds, or two-thirds of the total, were imported. Importation of some types of vegetable tannins have been either eliminated or seriously curtailed. Most important, however, is the fact that about 139 million pounds, or nearly fifty percent of the total tannin this country used last year, was quebracho which is imported from Argentina and Paraguay. Any curtailment of this supply would result in a critical shortage of tannin.

Since Western hemlock bark constitutes the only adequate source of tannin to replace quebracho considerable work is being done on various technical aspects of the problem to aid in the necessary commercial development. Western hemlock bark at present is a waste material from the lumber and pulpwood industries in Washington and Oregon. Although earlier investigations have shown the technical feasibility of utilizing properly aged woods peeled bark for tannin manufacture, economic and other considerations have militated against the needed industrial development.

Under present conditions in the Pacific Northwest the bark occurs principally at the sites of pulping operations, mixed with a large proportion of wood, and some simple means for separation of the bark from the wood must be found. About half of all the material available comes from logs floated in salt water and data are required to determine whether tannin from salt laden bark can be used successfully for tanning. This work is being prosecuted intensively.

Other domestic tanning materials--studies for the development of domestic tanning materials were continued in cooperation with the Bureau of Plant Industry and Soil Conservation Service. A method has been developed for producing a high purity tannin extract from canaigre containing approximately 65 percent tannin. By laboratory tanning in a straight canaigre liquor, pieces of hide previously struck in a tara liquor were successfully converted into heavy leather of the sole leather type. Studies on sumac as a source of tannin are being continued. Other domestic sources of tannin investigated are sitka spruce bark from Oregon and Washington, Florida mangrove, Chinese chestnut (Castanea mollissima), acacias, tung hulls, sage brush, sericea lespedeza, pecan shells, sun hemp, and others.

Conservation of chrome supplies--light hides and skins are tanned for the most part into chrome leather which usually contains about 3 to 5 percent chromic oxide. Chromium is a strategic material in National Defense. Much of it now used in the leather industry could be released by substituting for chrome-tanned leathers equally serviceable leathers made by tanning processes that require no chromium or only small amounts of chromium. Alum retanned

vegetable leathers when subjected to the boiling test have proved equal to chrome leather and definitely superior to straight vegetable leathers with respect to their resistance to heat. This indicates that these leathers should be more serviceable for use under severe heat conditions such as those encountered by the armed forces in desert regions. Tannages and treatments that produce leathers of better durability and greater resistance to deterioration by acids and heat increase the serviceability of leather and thus conserve both hides and tanning materials.

WESTERN REGIONAL RESEARCH LABORATORY

PROJECT STATEMENT

Project	1942	1943 (estimated)	1944 (estimated)
1. Construction and equipment of building	\$109,589	\$ - -	\$ - -
2. Apple utilization investigations (a) ..	60,362	68,150	68,150
3. Alfalfa utilization investigations	96,311	53,830	53,830
4. Fruit utilization investigations	196,924	279,760	279,760
5. Potato utilization investigations (a) .	37,644	31,260	31,260
6. Poultry utilization investigations	116,930	183,600	183,600
7. Vegetable utilization investigations (a):	132,158	242,600	242,600
8. Wheat utilization investigations (b) ..	55,798	94,850	94,195
Unobligated balance	24,534	- -	- -
Total estimate 1944 and comparable amounts 1943 and 1942	830,250	954,050	953,395

(a) Joint projects with Eastern Regional Research Laboratory.

(b) Joint project with Northern Regional Research Laboratory.

Examples of Progress and Current Program:

Construction and equipment of building: This project was terminated with the close of fiscal year 1942. All phases of building construction and fixed laboratory equipment installation required for full-scale operation of the laboratory at the beginning of fiscal year 1943 have been completed.

Apple utilization investigations: Investigation of the comparative emulsifying efficiencies of pectin and gums tragacanth, acacia and karaya (normally imported from Eastern Mediterranean countries in amounts approximating 24 million pounds) in olive, cottonseed, and mineral oil emulsions, has shown pectin to be superior to tragacanth for all conditions investigated and under certain conditions to be superior to acacia and karaya.

Formulae for tannic acid burn pastes and washable ointment bases utilizing

pectin as the thickening and emulsifying agent are being developed at the request of the United States Navy. Two of these formulae have been recommended to the general pharmacist by the American Pharmaceutical Association.

A pectic material has been developed, the physical properties of which closely resemble those of agar-agar (normally imported from Japan in amounts of approximately 500 thousand pounds annually). This material is undergoing tests in a number of laboratories to evaluate its usefulness as a replacement for agar-agar in the preparation of bacteriological media.

Work has been undertaken to prepare a nearly homogeneous ash-free pectin with osmotic pressure and viscosity characteristics, similar to those of normal blood plasma and which will be suitable as a transfusion fluid.

A simplified method of recovering pectin for industrial use has shown excellent promise in laboratory tests and will be developed as rapidly as possible.

Dehydrated apple powder has been produced from both apple juice and apple pulp on a semi-pilot plant scale. The powders reconstitute to apple product of agreeable and characteristic flavor.

Alfalfa utilization investigations: Carotene, a source of vitamin A, is being extracted from alfalfa by a counter current extractor using various solvents. The 0.4 pound of carotene in a ton of alfalfa, at a recent lease purchase price, has a value of \$106.00 and is sufficient for 100,000 people for one day for the prevention of "night-blindness" and the maintenance of health.

Since alfalfa meal, such as would be used as a source of carotene, must be stored for a considerable time, methods of storage which will minimize the usual loss of carotene by oxidation have been studied. The carotene present in the fresh alfalfa may be preserved in great measure by prompt dehydration after harvesting, and then storing the dehydrated meal either in a refrigerated warehouse, or in a storage space in which air has been replaced by an inert gas such as a mixture of carbon dioxide and nitrogen. The conditions which must be maintained in such inert gas storage have been determined in the laboratory.

Certain antioxidants such as diphenylamine, preserved up to 80% of the carotene in food and feed, whereas under similar tests without the antioxidant, practically all the carotene was lost.

A stabilized green pigment for camouflage use, which possesses desirable infra-red reflecting properties, and which gives photographic responses in the infra-red similar to natural foliage, has been prepared from alfalfa. This information has been transmitted to the Army Engineers Board, Fort Belvoir, Virginia, in accordance with their request for a stable green pigment having an approximation of the optical properties of chlorophyll as a possible substitute for critical mineral pigments.

Fruit utilization investigations: The research program on the preservation of fruits by freezing and freezing storage has been modified to a considerable extent in order to provide solutions as quickly as possible to problems arising from the rapidly changing industrial conditions. The prefreezing steam blanching treatment for apricots and peaches for these fruits that are to be preserved for use in pies, jams, preserves, and baby food manufacture was adopted by a number of packers during the past season. Several million pounds of fruit were preserved by this method which protects it from flavor and color changes during freezing storage and subsequent defrosting.

It has been found that the important but illusive vitamin C occurring in many fruits can be stabilized and preserved in raspberries by the proper adjustment of acidity. It is planned to extend this type of research to other fruits preserved by freezing.

The shortage of butter fat which threatens to reduce or terminate the manufacture of ice cream has given rise to research on making a highly nutritious frozen dessert from fruit puree containing added sugar or corn syrup, citric acid and a colloidal stabilizer.

Pectin investigations as applied to apples are being pursued on other fruits, particularly on the citrus varieties. In addition, partial demethoxylation of pectin by alkaline, acidic and enzymic treatments to produce a low-sugar jellying pectin as a sugar-conserving agent and a material which will set up a gelatin-type of gel when dissolved in cold water has been undertaken. Interest in the latter material has been expressed by representatives of the Office of Quartermaster General.

The United States annually requires about 15 million pounds of tartaric acid, substantially all of which was imported prior to the war. Research has resulted in the development of the pilot plant stage, of a process for recovery of tartaric acid from wine pomace and brandy still slop, which sources are potentially sufficient to supply a major portion of the impending deficiency. Pilot plant studies indicate that commercial success of the process is dependent upon the useful life of the "ion exchange" resins involved. Laboratory studies on progress indicate that this is sufficiently long to make profitable operation possible.

The surplus of dehydrated fruits existing before the United States entered the war has been wiped out by heavy purchases for the armed forces and for lend-lease. Additional dehydrating capacity during the coming season will be required both because of continued emergency demand and because of disruption of transportation facilities and canning facilities. Research is being conducted on methods of dehydrating fruits, particularly berries, for which there has been no appreciable dehydration industry in the past. Products of excellent palatability and vitamin potency have been prepared experimentally. Studies of methods of preparation, drying, and packaging are being continued. Equipment suitable for handling these fruits by recommended methods has been designed. Emphasis has been placed especially on prompt dissemination of the knowledge thus obtained and on direct technical assistance to the operators of plants which are entering this field for the first time.

Plasticizer materials for the production of vinyl and cellulose ester plastic have been in serious shortage due to the increased requirements for plastics of these types and to the necessity of diverting some of the current plasticizer materials to the production of more urgent war materials. Investigations have been undertaken to relieve this situation by developing suitable plasticizers from materials, such as vegetable oils and their derivatives, which show considerable promise as plasticizers for both vinyl and cellulose ester plastics.

Potato utilization investigations: During the past year the necessity for provisioning large expeditionary armies overseas and for increasing lend-lease shipments of foods has coincided with extreme shortage of ocean shipping space, so that reduction of the weight and bulk of these foods has become essential. Dehydration has offered the most promising approach. Estimated Government requirements for dehydrated vegetables indicate that a hundred-fold increase in production over pre-war years must be attained; approximately half of the total will be dehydrated potatoes. The rapid creation of an industry of this magnitude presents technological problems of great difficulty. The Bureau of Agricultural Chemistry and Engineering started active work on these problems before the situation actually became acute, and has been able to supply guidance with respect to methods and equipment and to assist in training operators for hundreds of prospective dehydration plants.

A comprehensive research program covering all phases of the process is under way; selection of raw material, washing, peeling, cutting, blanching, drying, packaging, storing, and methods of evaluating quality are being investigated. Many pieces of equipment for use by the industry have been designed, and copies of the designs have been furnished to many hundreds of inquirers. Applications for public service patents on a radiant heat peeler for potatoes and other root vegetables, and on improved tunnel dehydrator, have been filed. Improved methods of preparation, drying, and packaging are being incorporated in Government purchase specifications as rapidly as they can be verified, and are being transmitted to active and prospective dehydrators through conference, correspondence, mimeographed releases, and through actual training of operating personnel. Operating tests are being made at plants during the difficult starting-up period in order to shorten the inevitable stage of trouble and low production. Further development of the investigation will emphasize this aspect of direct help to new plants, but further efforts will be made to discover means of improving the quality of dehydrated potatoes. Cooperation is being maintained with the Quartermaster's Corps of the Army, the War Production Board, the Agricultural Marketing Administration, the British Food Mission, officials of other allied nations, and investigators along related lines in colleges, experiment stations, and private industry.

A study has been made to determine the feasibility of air-drying as a means of conserving cull potatoes for industrial utilization as raw materials for the manufacture of starch, alcohol, or other products. The cull tubers of which the State of Idaho alone produces some 5 million bushels, were found to dry satisfactorily in vertical racks 4 inches in width when the potatoes were cut into pieces $3/8$ or $1/2$ -inch cross section, provided favorable weather

conditions prevail. The tests, carried out at Aberdeen and Caldwell, Idaho, indicated that the season when culls are available and weather also suitable is in most years, a very short one. Tests are in progress to determine the usefulness of the dried potatoes as industrial raw material.

Poultry utilization investigations: Comparative studies of a wide range of freezing temperatures for storage of poultry and liquid eggs have clearly demonstrated the importance of 0° or subzero F. temperatures for retention of good quality. In the light of the tests mentioned, civilian and army buyers are warranted in insisting that frozen poultry and eggs have an acceptable storage history.

It appears from experimental evidence that undrawn poultry is somewhat less prone to becoming rancid in freezing storage than is drawn. Tests indicate that an excellent, 100% edible food may be prepared from sound, though not choice, chickens by steaming the dressed fowls, boning, compacting, freezing, and glazing. The product seems well adapted for use in army camps.

Tensile strength and stability of artificial fibers from technical grades of egg albumin have been considerably improved by special treatments involving the use of a commercial detergent, and by physical stretching manipulations under steam heat. These improvements are found to be closely correlated with corresponding improvements in molecular structure, as shown by X-ray studies. These fiber investigations contribute to the endeavor to find or develop substitutes and/or replacements for priority and critical materials such as silk, wool, and nylon.

Feathers and related keratin protein substances such as hair, horn, hoofs, etc., have continued to show worthwhile possibilities as raw materials for adhesives, for sizing and coating purposes, and as useful ingredients of thermo-setting molding compounds. Adhesives thus far produced have the properties of animal glue. They have been found effective as sizing and coating substance for the oil proofing of paper and pulp containers. This has definite application in connection with the acute shortage of metal for containers. Keratin protein has shown good properties when mixed with urea-formaldehyde and a filler in thermo-setting molding powders, the molded articles having superior strength, toughness, and water resistance.

Lend-lease operations and army needs have caused large increased demand for dried eggs. In cooperation with state and private organizations, studies are under way dealing with retention of quality during processing and storage as measured by deterioration of nutritionally valuable components.

Experiments are in progress to find methods for isolating and recovering from poultry products constituents which may be of importance in the maintenance and regulation of blood pressure. The use of such substances is indicated in medical treatment during shock, supplementary to or replacing blood transfusions.

Vegetable utilization investigations: Superimposed on the rapidly mounting need for dehydrated vegetables to supply the requirements of the armed forces and lend-lease shipments is a growing shortage of tin and sheet steel which is already driving more and more of the nation's food supply away from the common method of preservation by canning. Aside from potatoes the vegetables which must be dehydrated in greatest amount for Government purchase are onions, cabbage, carrots, beets, turnips, and sweet potatoes; as the supply of cans becomes shorter, peas, snap beans, sweet corn, tomatoes, and numerous minor vegetable crops must be added to the list. In cooperation with the Division of Agricultural Chemical Research of the Bureau of Agricultural Chemistry and Engineering, research on methods of dehydration which will preserve the palatability and nutritive value of all these vegetables is being pushed. Reasonable satisfactory methods for many of them have been worked out and used as the basis for Government purchase specifications. Recommended methods have been published and several hundred plant operators have been trained in their use. Designs for suitable equipment and complete plants have been widely distributed in order to expedite the construction or alteration of plants in preparation for large-scale dehydration of vegetables. Improvements in all stages of the process are still being sought. More and more emphasis is being placed on direct technical assistance in the planning, construction, and starting up of new plants, so that production capacity of the nation may be built up rapidly enough to meet the war need.

A rapid test has been perfected for determining the sanitary history of frozen pack peas and its applicability to other frozen vegetables is being actively investigated. It should prove of particular value to the military authorities who have announced their intention of buying approximately 71 million pounds of frozen vegetables in 1943.

At the request of the Office of the Quartermaster General, extensive studies of frozen vegetables under conditions simulating those in army camps and augmented by actual observations in army posts have shown the feasibility of using such foodstuffs on a large scale thereby freeing canned and dehydrated foods for overseas consumption.

During the past year the work concerned with the freezing preservation of vegetables has been largely centered around the accumulation of data for the development of specifications and grades in cooperation with the Agricultural Marketing Administration for frozen vegetables. To date the Agricultural Marketing Administration has been provided with information concerning the development of specifications for frozen lima beans, corn, broccoli, cauliflower, spinach, and Brussels sprouts.

Considerable attention was devoted to the development of a freezing preservation technology for edible soybeans. This technology has been almost completely worked out and should have considerable significance since the edible soybean is relatively a new product deserving considerable attention because of its high nutritional value.

The wastes resulting from harvesting and preparing vegetables for the market are about 50% of the crop. Economic survey of the factors involved has been undertaken with the purpose of finding new uses for culls, harvesting, and processing wastes. Chemically these materials consist largely of water and fibers. Some of the vegetable fibers have been found to be of likely utility as fiber board or insulating materials. A patent application has been made for a processing method for fiber board manufacture and semi-commercial scale producing methods will be investigated.

Wheat utilization investigations: Further work on the isolation, recovery, drying, and stabilization of wheat gluten protein, in quantity and condition suitable for industrial utilization, has been carried out. Possible utilization as sizing and coating materials, and as artificial fibers are being investigated. A sulfate derivative of wheat gluten has shown extraordinary gel-forming power, extremely high water absorbing capacity, and interesting wound healing properties. A new and seemingly improved method of making glutamic acid from wheat gluten shows considerable preliminary promise. This product is in great demand as a meat-like food flavoring substance and is now a war priority material.

Wheat straw and other agricultural residues contain 20-35 percent of hemicelluloses composed to a large extent of the sugar, xylose. Xylose is readily recoverable and on reduction yields xylitol, a polyhydric alcohol, whose physical properties lie between those of glycerol and sorbitol and shows promise as a satisfactory replacement material for certain uses of these materials. Experimental samples of xylitol have been submitted to tobacco companies for test as a humectant and to an explosives manufacturer for investigation of the potentialities of the nitro derivatives. Numerous xylitol esters and others have been synthesized and are being tested as plasticizer materials. The lower fatty acid esters of xylitol show promise as plasticizers for cellulose ester resins.

Investigations of the possible usefulness of wheat and wheat processing by-products as raw materials for the microbiological production of medicinally useful alkaloids are in progress.

CENTRAL ADMINISTRATION

This project provides for the administrative supervision and direction of the work of the four regional research laboratories. Its objects are (1) to develop a well coordinated research program for the laboratories, (2) to maintain proper control in order to avoid duplication of research activities, and (3) to maintain in Washington centralized control and direction of the business activities necessary for the proper functioning of the organization as a whole, including personnel, budget, bookkeeping, auditing, purchase and property, editorial and information, files, etc.

During the past year, the Central Administrative Staff has conducted the administrative operations dealing with the development and coordination of the

research projects for the four laboratories, and has exercised the necessary business service control. Conferences have been held with the Directors of the four laboratories in order to maintain proper coordination among the activities of the laboratories and the other research agencies of the Department. Programs of the laboratories have been redirected, or the emphasis shifted, to meet the wartime problems arising out of shortages in the production of industrial materials required for increased military and civilian demands.

PASSENGER-CARRYING VEHICLES

It is not contemplated that any new passenger-carrying vehicles will be purchased for use at the Regional Research Laboratories. It is expected that five automobiles will remain in use.

AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF HOME ECONOMICS

SALARIES AND EXPENSES

Appropriation Act, 1943	\$368,890
First Supplemental National Defense Appropriation Act, 1943	20,000
Proposed transfers in 1944 estimates to:	
"Salaries and expenses, Library"	-1,620
"Salaries and expenses, Office of Administra- tor, Agricultural Research Administration"	-1,000
Total available, 1943	<u>388,270</u>
Budget estimate, 1944	<u>366,131</u>
Decrease (including decrease of \$139 travel funds returned to surplus)	<u>-20,139</u>

PROJECT STATEMENT

Project	1942	1943 :(estimated):	1944 :(estimated):	Increase or decrease
1. Foods and nutrition investi- gations	\$92,606	\$117,952	\$97,952	-\$20,000
2. Family economics investiga- tions	94,397	99,050	99,050	- -
3. Textiles and clothing investi- gations	103,670	107,459	107,459	- -
4. Housing and household equip- ment investigations	28,307	28,755	28,755	- -
5. Home economics information ...	28,730	32,915	32,915	- -
Covered into Treasury in accord- ance with Public Law 674	- -	139	- -	-139
Unobligated balance	7,000	- -	- -	- -
Total estimate 1944 and com- parable amounts 1943 and 1942	354,710	386,270	366,131	-20,139(1)

INCREASES OR DECREASES

(1) The decrease of \$20,139 in this item for 1944 consists of \$139 decrease in travel funds (returned to surplus in 1943) and:

A decrease of \$20,000 for "Foods and nutrition investigations" due to the dis-
continuance of work on methods of preparation, palatability and nutritive value

of dehydrated foods such as leafy green vegetables, green snap and lima beans, peppers, pumpkin and squash, for which a supplemental appropriation was provided in 1943.

WORK UNDER THIS APPROPRIATION

Objective: Information for wartime living: The full impact of the war is now registering on every home in the Nation. Rationing of food and other goods brings drastic changes in everyday living. To help families make these adjustments with least danger to health and well being, the Bureau of Home Economics is charged with providing the public with information based on its scientific research in foods and nutrition, clothing and textiles, household equipment, and family economics.

The Problem and its Significance: The Nation's families are resolutely accepting the hard fact that for the duration we must live without many of the usual goods and services. The research of the Bureau of Home Economics is facilitating the adjustment required.

How to use the Nation's food supply so as to maintain the highest possible level of nutrition is a major problem of wartime. Every fact gained by the Bureau of Home Economics through its years of research in foods and nutrition is now called into even more active use. But the present global struggle with its lightning-like changes constantly poses new questions, demanding new research conducted with all possible speed. Tests on new foods to replace better known kinds needed for shipment overseas must be conducted continuously. Shortages of tin and rubber for containers for home-canned foods necessitate developing or perfecting home drying and other methods of household food preservation. As our food supplies grow more restricted, the public demands information as to how it can get the greatest possible nutritive value from supplies obtainable.

In clothing, household textiles, and household equipment, conservation is the basic aim for the duration of the war. Not only is the manufacture of new goods for civilian use greatly curtailed, but every purchase in the retail market tends toward inflation. Much of the Bureau of Home Economics research in these fields has already been redirected to furnish facts on home care and repair of the major items of clothing and household equipment. As existing stocks dwindle and articles now in service become more worn, this work must be intensified and spread to other articles not yet on the list of critical materials.

General Plan: In this Bureau, research has been redirected to serve war and postwar purposes. Under the wartime program, each docket of facts developed through the Bureau of Home Economics research is reviewed for all possible uses. Some marked "confidential" must be held for the exclusive use of Government agencies including the Army and Navy. Technical reports are channeled directly to professional workers so results may be pooled and no work duplicated. Practical how-to-do-it information goes at once to the public in the form of folders, flyers, picture charts, press and radio releases, for immediate use in adjusting family living to the vicissitudes of war.

Examples of Progress and Current Program:

Project 1 - Foods and nutrition investigations: Since it is recognized that "Food will win the war and write the peace" all research in the Foods and Nutrition Division is now keyed to furnishing information essential to the war effort. The following are outstanding contributions:

Dehydrated and canned foods: Commercially dehydrated food: As a basis for specifications for food purchased under Lend-Lease and for the use of military services, a great variety of commercially dehydrated foods--eggs, vegetables, fruits, meat--were tested for palatability, cooking quality, and vitamin and mineral content. Looking toward improvement in dehydrated products, similar studies are made on samples of known history at different stages of the dehydration process and storage.

Home dehydrated food: To meet the shift in home-preservation methods necessitated by shortage of tin and rubber for containers, home-drying equipment and methods are being developed for vegetables and fruits from home gardens. These home dried products are likewise tested for nutritive value and storage qualities under home conditions. Preliminary directions for home drying were distributed to the public during the summer as an aid to the food conservation program during the season of abundant fresh fruits and vegetables, and the work is being pushed to perfect methods before the next season of fresh fruit and vegetable abundance.

Funds for this project were made available to the Bureau in November, 1941, in the amount of \$74,000. These funds expired June 30, 1942. The project is being continued in 1943, under a supplemental appropriation totaling \$20,000, for work on methods of preparation, palatability, and nutritive value of dehydrated foods such as leafy green vegetables, green beans, peppers, pumpkin, and squash.

Because of the acute shortage of raw rubber and likewise the imperative need to conserve food by home canning, tests are under way on rubber gaskets for glass jars made with various percentages of crude and reclaimed rubber. These gasket tests now cover also gaskets made with Norepol (developed in the Northern Regional Research Laboratory of the Department of Agriculture) and other synthetics suggested as rubber substitutes.

Soybean and other protein concentrates: In line with the greater production of soybeans and peanuts for oil, uses are being found for the other derivatives of these products rich in protein, minerals, and vitamins. These and other protein concentrates, both alone and in combination with the less nutritious staple foods, are being studied. Such fortified foods are particularly valuable for supplementary diets of children under the school lunch program and for shipment abroad under Lend-Lease and for relief feeding. Various percentages of soya have already been tested in cereals, soup mixtures, and a number of baked products. The expansion of these investigations has been made possible through an allotment of funds from the Agricultural Marketing Administration.

Wartime food recipes: War necessitates rapid changes in our customary methods of cooking and introduces new foods to replace familiar kinds not available or abundant under emergency conditions. This calls for quick adjustment of standard recipes, for directions to accompany new foods, and for aid in winning ready acceptance, thus avoiding waste of valuable supplies.

The Bureau of Home Economics through its years of research in scientific food preparation is in the best position to supply the public with such wartime recipes. The following material, distributed on a nationwide scale, is indicative of what will be prepared to meet each crisis in the wartime food situation as it confronts civilians: "Recipes to match your sugar ration," "Sugar in wartime canning" (in cooperation with Office of Price Administration), and "Ninety-nine ways to share the meat" (at the request of the Office of War Information).

Nutritive value of foods essential for wartime planning: Adequate vitamin A, which is necessary for good night vision, is especially important for men on night duty in the air and on the sea. Studies have been made of the ability of the human body to transform carotene, the provitamin A, into vitamin A itself, since our usual supply of vitamin A from such sources as fish liver oil are reduced. Preliminary work, using only a few common vegetable foods, show that carotene in vegetables is not converted entirely into vitamin A in the body and that the degree to which it is converted may vary with the type of vegetable. Studies on rats are still under way which will help to establish a reliable conversion factor which will assist in evaluating the vitamin A content of plant foods. Results of this study will furnish urgently needed data for computing vitamin A value requirements and help in evaluating the vitamin A intake of different population groups.

The effect of maturity and storage under different conditions on the ascorbic acid content of different varieties of apples was completed. Also completed were studies on the vitamin C content of tomatoes of known variety and age grown on soils treated with various types of fertilizers. The value of 75 commonly used American foods was determined for one or more of the following vitamins: thiamine, riboflavin, ascorbic acid, beta-carotene (vitamin A). Ascorbic acid and thiamine losses during processing were studied in 39 foods.

Since human beings must get considerable portion of their thiamine from plant foods and since many American diets are low in this factor, a study of the vitamin value of pollen was initiated in cooperation with the Bureau of Entomology and Plant Quarantine. The thiamine (vitamin B1) content of several varieties of wheat grown in different parts of the country has been studied. Twelve varieties of flours from some of these wheats of different degrees of extraction and breads baked from these flours were analyzed for thiamine. Due to the pressure of war projects, this work on wheat and pollen was considerably curtailed. The reasons for not completely discontinuing these projects are that wheat is a very important constituent of the average American diet, and that pollen may prove to be an inexpensive and abundant agricultural product for enhancing the nutritional value of the diet.

The evaluation and compilation of thiamine, riboflavin, ascorbic acid, vitamin A, and vitamin D values in relation to processing and other variants found in

the scientific literature prior to January, 1941, was completed. Also for the use of dietitians and others needing such data, tables on the vitamin content of foods in terms of common measures (100 gram, pound, and average household servings) are now being distributed.

Compilation of data on food composition: The program of compiling data on food composition has been converted to problems relating directly to the feeding of military and civilian populations of the United Nations. Data on the nutritive value of 302 foods of special war-time significance have recently been made available for the use of military and government agencies. Data on other foods are being furnished as rapidly as possible. An index and table for rating nutritive values of foods have also been set up for the use of government agencies. Plans for facilitating the collection of existing, but unpublished, food composition data from all available sources for compilation by the Bureau have been set up at the request of the War Department by the National Research Council. Other typical services in this field include: The formulation of compact emergency rations for shipment to prisoners of war at the request of the Agricultural Marketing Administration and the American Red Cross. A short method of calculating the nutritive value of diets has been developed in co-operation with the Office of the Surgeon General. This method of appraisal takes only about one-fifth as much time as routine calculations formerly used. This enables the Quartermaster Corps to check the diets of troops in camps all over the country in a fifth of the time formerly required.

Project 2 - Family economics investigations: The wartime programs for rationing, reducing domestic consumption and planning for relief in other countries have drawn heavily upon the data from the Bureau's studies of what typical American families buy and use in their homes. Special analyses of data collected through field studies in 1935-36 and 1941-42 are yielding data for the use of the war agencies on such subjects as fuel consumption, clothing needs, income distribution, amount of savings, and other items in the family budget. The Bureau has furnished facts on nutritive values, quantities of food consumed, and possibilities of alternative foods for use in planning for point rationing, for stockpiles, for overseas relief during military occupation and the post-war period, for the voluntary meat-sharing campaign, and for agricultural production in wartime.

Family spending and saving in wartime: The 1941-42 field study of Family Spending and Saving in Wartime has been completed and the major findings analyzed and made public. This study covers the distribution of income among farm families and the amount and proportion of income that goes into savings and into expenditures for food, clothing, household operation and other items. More detailed analyses are being made at the request of such government agencies as: the Extension Service - material to assist farm families to adjust to wartime living conditions; the Treasury Department - special tabulation of variations in expenditures for living within income classes; the National War Labor Board - a tabulation of salaries and wages for the purpose of wartime control of individual incomes; the War Production Board and Office of Price Administration - a complete inventory of clothing possessed and purchased by rural families as a guide in production, conservation, and rationing.

Family budgets: Standard budgets are being formulated to meet the needs of families of various types, using data collected in studies of family spending and saving both in peacetime and during war. In a period of planned production, war taxation, bond sales and rationing of certain foods and materials, one of the most frequent questions asked by Federal administrative agencies is: How much of this or that commodity does a family really need? In the period immediately succeeding the war, during which planned American production and marketing may be extended to even larger territories of the world, the question will be asked even more frequently. Adequate budgets for food needs of American families have been previously developed in the work of the Family Economics Division. Items of the family budget other than food have not as yet received detailed attention. The problems remaining to be explored here include methods of determining what kinds and amounts of clothing, household textiles and equipment, housing, and other items of living are needed, taking into account such variable factors as size of family, etc.

War relief in other countries: To meet our responsibilities to the United Nations and the occupied countries, corresponding estimates are being made of their needs. In cooperation with the State Department and the Lend-Lease Administration, facts are being assembled about the food habits and needs of these countries. Similarly a clothing budget for people living in both warm and cold climates has been prepared, and estimates made of the costs of raw goods and finished garments.

Post-war planning for family living: The economic aspects of family living in the post-war period are being considered in cooperation with the Department's Inter-Bureau Committee on Post-war Planning. The purpose of this is to define the long-time objectives and steps to be taken by farm families toward those objectives. Estimates are being made of the depletion in consumers' goods and the probable needs for replacement of clothing, household furnishings and equipment and for improvement in housing.

Outlook reports: Periodic reports are prepared for use by the Extension Service and other agencies on the economic situation with regard to rural family living. These are discussed particularly in terms of food, clothing, furnishings, household equipment and other items of consumers' goods.

Project 3 - Textiles and clothing investigations: The Bureau's research on textiles and clothing has been redirected to provide information needed for the war program. Current projects are developing methods of conserving textiles, both in the home and in military use, and are assisting homemakers in the selection, use and care of the limited supplies on the retail market. Typical examples are:

Wool and wool substitutes: Only small amounts of wool are now available for civilian needs. Investigations on wool fabrics, including the effect of substitutes upon the durability, warmth, and other qualities of suitings and blankets, provide data essential to making the best use of this supply. Similar studies are urgently needed on the use-value of replacement fibers developed as a result of the war.

At the request of the Quartermaster General's Office, work is under way on the use of furs to replace some of the wool in clothing for combat troops in extremely cold climates. Studies are also being conducted on the care, storage, and sterilization of wool fabrics in clothing and household articles.

Sterilization of footwear: At the request of Army officials the work on the sterilization of textiles now includes methods for sterilizing leather footwear to reduce loss from mildew and to prevent infection with athlete's foot. Growth of mold on leather is particularly serious in jungle warfare where temperatures and humidity are high. Under tropical conditions the disability and discomfort caused by "athlete's foot" is also accentuated, and even in temperate climates this disease is of concern to our armed forces.

Cotton for clothing and other household, farm and military uses: The 200 designs for women's full fashioned cotton hosiery developed as part of research begun at the request of Congress 3 years ago are now being widely adopted by manufacturers as they shift from silk and nylon hose to cotton and rayon. To aid in breaking the bottleneck caused by scarcity of long-staple cotton and fine-count yarns formerly imported from Britain, studies are now continuing on single yarns spun from medium-staple cotton. Research is under way on chemical finishes and constructions that will give these single yarns the necessary strength and elasticity.

The present limited spindle and loom capacity makes it important to stress the development of mildew and rot-resisting treatments for materials used for sandbags, tents, camouflage nets, tarpaulins, seedbed coverings, awnings, and various other military, farm and household purposes. In cooperation with other bureaus, a rapid, reliable method is being developed for determining the effectiveness of chemical finishes for these fabrics. Results of this work are being used by the Army in testing the mildew and rot-resistance of cotton military equipment.

Buying guides for consumers: Higher prices, lower quality, reduced quantities, the use of substitute fibers about which little is known -- all add to the consumer's difficulty in evaluating market offerings of textile goods in wartime. The present war, with its attendant enormous demands upon some textile fibers and upon manufacturing capacities has already resulted in the total disappearance of certain household and clothing fabrics ordinarily found in retail stores and in a decided change in the quality and fiber content of others. Through the preparation of textile buying guides the Bureau is assisting household purchasers in making the wisest selections possible and thus conserving raw materials, labor and manufacturing equipment for the production of military fabrics. Specifications are also being developed for civilian textiles in order to discourage the lowering of quality, especially of fabrics used in work clothes which are now in such great demand.

Fabric and clothing conservation: War always necessitates the care, repair and remodeling of clothing and household fabrics, as the supply of textile goods dwindles and replacements become uncertain. Home sewing likewise increases in order to offset rising living costs, lowered fabric quality found in ready-to-wear clothing in specific price ranges and decreased supplies of ready-made articles due to the shifting of factory labor to war industries. The Bureau has accordingly redirected its clothing research to provide prac-

tical helps to homemakers on remodeling adults' garments for additional wear or for the use of children, and special techniques for mending men's suits, woolen household textiles and other items irreplaceable during the war.

Functional clothes for wartime jobs: Designs for women's work clothes were developed by the Bureau and released to pattern and garment manufacturers early last year -- thus starting a clothes-for-work trend, of great benefit to women, which has already developed into one of the major aspects of the women's clothing industry. Bureau designs are now in production for nurses, for factory workers and for women driving tractors and carrying other increased responsibilities in outdoor and indoor farm work. These designs stress safety and comfort for the worker as well as economy of fabrics and of construction detail. In response to requests, the Bureau is now working with the aircraft industry, inspection services and other agencies on specially designed garments.

Project 4 - Housing and household equipment investigations: Household food preservation equipment: Metal and rubber shortages, curtailing production of steam pressure outfits and other equipment commonly used in canning, demand development of other types of equipment for home food preservation. Work is therefore underway in the equipment laboratories on improving dehydrators developed during the last war and developing new designs. This is important since the situation demands that an increasingly larger proportion of home-preserved food be in the dried form. The Bureau has released to the public an improved design for a kerosene dehydrator.

To aid in the sharp freezing of food at home, various types of cabinets are under test. At the request of the Rural Electrification Administration, test data were furnished on a specially designed sharp-freezing and storage cabinet as the basis for construction and performance specifications to be used in manufacturing a moderate-cost cabinet as soon as priorities permit.

Conservation of household equipment: The acute labor situation emphasizes the need for labor-saving devices in the home. At the same time the military program has cut off the supply of metals and other materials for the manufacture of this type of civilian goods. Homemakers therefore need to use all care for all existing equipment so that it will last until factories can again turn out this type of goods. The Bureau is preparing practical directions for care and use of all household equipment. Already issued and widely distributed are leaflets on washing machines, ironing equipment, ranges, refrigerators. Also a set of charts, entitled "Fight Food Waste" and showing how to store all the common foods, is being widely used by adult study groups, consumer information centers, and schools as part of the wartime food conservation program. As an aid in the reconditioning of home sewing machines, a manual for the use of group leaders in conducting sewing machine "clinics" has been developed in cooperation with the University of Maryland Extension Service. As the situation on household equipment becomes more stringent, we must be pushed to provide more material of this kind on other pieces of equipment.

Performance standards and standard test methods for new and rebuilt household equipment: With establishment of price ceilings for household equipment, performance standards and simple standard test methods, both for new equipment made of substitute materials and for rebuilt equipment, are essential to consumer protection. A beginning has been made by the Bureau in data furnished the Office of Price Administration on performance standards for refrigerators, drawn from previous research. Work is now under way to provide simple test procedures on refrigerators, ranges, and hand irons, and should be pushed to cover all common articles of household equipment.

Special services: Specifications for all types of household equipment on the market during 1941 were compiled for the Office of Price Administration as a basis for the development of programs on simplification, recommended standards and curtailment of production. As a further aid in the simplification program the Office of Price Administration requested the Bureau to make a survey to determine the value of special features in major pieces of household equipment in relation to their usefulness and the amount of strategic materials used in construction.

Prior to the issuance of the order curtailing the manufacture of cooking utensils, the Bureau prepared the recommendations of the Department for submission to the War Production Board.

At the request of the American Red Cross a homemade fireless cooker was developed for use in emergency feeding and canteen work. This was designed to meet the safety requirements of the National Fire Underwriters' Association, with nonstrategic materials used as far as possible. Specifications and directions for construction were prepared for the use of Red Cross classes. Assistance was given the Red Cross in selecting portable kerosene stoves for shipment abroad.

Farm house requirements: The farm kitchen study has been discontinued for the duration of the war. The data from the project have been analyzed and are available for use in the war housing program. The staff has been transferred to work on sharp freezers, home dehydrators and on the preparation of material for the defense leaflets on conservation.

Project 5 - Home economics information: Civilians faced with wartime rationing of food and rapidly diminishing supplies of clothing and household goods are urgently seeking for scientific facts to help them make the necessary adjustments with least danger to health and well-being.

The home economics information program is devoted completely to meeting this wartime demand. By printed bulletin, picture chart, radio broadcast, and press release, a constant flow of authoritative how-to-do-it information is moving out to the homes of the Nation.

When consumer campaigns are organized by the Office of War Information, the Bureau ties its material in with that of other agencies. For example, for the Share-the-Meat Campaign the Bureau prepared a folder "99 Ways to Share the Meat" of which 10 million copies were distributed through the state and local units of the Office of Civilian Defense in cooperation with nutrition committees of the Office of Defense Health and Welfare Services. Likewise, at the request of the Office of Price Administration, a series of folders were issued

to help prolong the life of such household equipment as washing machines, refrigerators, cookstoves, ironing equipment, vacuum cleaners, electric cords and plugs, and household rubber articles. A third example is the follow-up for the Victory Garden Campaign in the form of directions for canning, drying, pickling, and the modern way to cook vegetables so as to conserve food value.

SUPPLEMENTAL FUNDS

Direct Allotments

Project	Obligations: 1942	Estimated obligations: 1943	Estimated obligation: 1944
<u>Special Research Fund: For special researches in nutrition</u>	\$19,185	\$20,000	\$20,000
<u>Salaries and Expenses, Agricultural Administration: For a study of the utilization of surplus agricultural commodities</u>	4,920	--	--
<u>Exportation and Domestic Consumption of Agricultural Commodities: For a study of the utilization of surplus agricultural commodities</u>	17,540	27,800	19,460
<u>Liquidation and Management of Resettlement Projects: For the testing of textile materials which are sold on resettlement projects</u>	3,025	3,180	3,180
<u>Emergency Dehydration Investigations: Investigations of the effect of dehydration processes on the quality, uses and nutritive value of foods</u>	59,973	--	--
<u>Emergency Fund for the President, National Defense: For a study of spending and saving of rural families in wartime ...</u>	90,397	19,603	--
<u>Working Fund, Agriculture, General, (Transfer from War Department): For statistical and other services in connection with a cost-of-living survey ..</u>	1,000	--	--
<u>Working Fund, Agriculture, Agricultural Research Administration (Transfer from Office of Scientific Research and Development): For investigations regarding conservation and nutritive values of fruits, vegetables and cereal grains</u>	--	15,500	--
TOTAL, SUPPLEMENTAL FUNDS (Direct allotments)	196,040	86,083	42,640

BELTSVILLE RESEARCH CENTER

Appropriation Act, 1943	\$105,855
Budget estimate, 1944	<u>100,560</u>
Decrease	<u><u>-5,295</u></u>

DECREASE

The decrease of \$5,295 in the 1944 appropriation estimates will involve a curtailment in the maintenance of roads at the Center.

WORK UNDER THIS APPROPRIATION

Objective: The orderly development of the Beltsville Research Center and the maintenance of operating services and related management functions.

The Problem and its Significance: This appropriation provides, not for research work, but for over-all operating services and related management necessary primarily to the efficient conduct of the work performed at the Center by the various research agencies of the Department. These services include operation of a sewage disposal system; procurement and maintenance of fire protection equipment; construction and maintenance of roads; operation of mail and messenger services; construction and maintenance of water, gas, and electric distribution lines; provision for emergency first aid service; centralized purchasing of fuel, feed, and other supplies; furnishing of central telephone and guard services; and maintenance of administrative services in connection therewith.

Direct services furnished to the agencies conducting work at the Center, such as heat, electricity, gas, and water, the repair and maintenance of structures and equipment and the conduct of general farm work, as requested by the bureaus, are performed on a reimbursable basis.

Examples of Progress and Current Program: Continuous progress has been made during the year in improving the efficiency of the services rendered to the various agencies by the Beltsville Research Center. This progress is especially noted in connection with the manner in which the Center has kept pace with the everchanging requirements of the agencies caused by the conversion of their normal activities to work contributing directly and indirectly to the war effort. During the past fiscal year, the agencies have continued to transfer personnel and their work from Washington to the Center, resulting in an increased expansion on the part of the Center to meet this greater volume and diversity of activities.

Improvements in facilities made at the Center during the past year included providing an increase in the storage capacity and more uniform pressure of water both for experimental work and for protection of buildings, and institution of full-time guard service throughout the areas of the Center which might be most subject to damage from sabotage or fire.

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SUPPLEMENTAL FUNDS

Direct Allotments

Project	Obligations, 1942	Estimated obligations, 1943	Estimated obligations 1944
<u>Public Works Administration, Act of</u>			
<u>1938 (Allotment to Agriculture,</u>			
<u>Beltsville Research Center): For</u>			
<u>construction and improvements at</u>			
<u>Beltsville Research Center</u>	7,288	3,885	--
<u>Public Works Administration (Allot-</u>			
<u>ment to Agriculture, Secretary's</u>			
<u>Office): For construction of film</u>			
<u>storage vault</u>	3	39	--
<u>Emergency Fund for the President,</u>			
<u>National Defense (Allotment to</u>			
<u>Agriculture): Moving certain</u>			
<u>facilities of the Bureau of</u>			
<u>Animal Industry to the Beltsville</u>			
<u>Research Center</u>	6,580	15	--
<u>Emergency Relief, Agriculture,</u>			
<u>Beltsville Research Center, Pub-</u>			
<u>lic Buildings, Parks, Utilities,</u>			
<u>Flood Control (Transfer from</u>			
<u>W.P.A.): Public building, Utili-</u>			
<u>ties, etc.</u>	334	--	--
<u>TOTAL, SUPPLEMENTAL FUNDS</u>			
<u>(Direct allotments)</u>	14,205	3,939	--

